WEIGHT MAINTENANCE FOLLOWING THE COMPLETION OF A WEIGHT LOSS TRIAL: EXPLORING RACIAL DIFFERENCES

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Overweight and obesity are widespread, global health problems due in part to the relapse and weight gain that often follows weight loss treatment. Moreover, racial minorities are disproportionately affected by this chronic disorder. Empirical evidence is needed to better address the problem of poor weight maintenance after loss.

This ancillary, prospective study examined weight maintenance 18 months after a behavioral weight loss trial and explored possible differences between black and white participants in percent weight change and successful weight maintenance. The relationships of psychosocial variables— experiences following a low-fat diet, barriers to healthy eating, self-efficacy for resisting eating and for exercising, social support, and stress— with weight maintenance were investigated as well as whether race moderated these relationships. Additionally, the study examined the behavioral strategies used for weight maintenance and explored dietary intake and physical activity as potential mediators of the relationship between psychosocial variables and weight maintenance.

Hierarchical linear and logistic regression models were used to examine the effect of race, as well as the effect of psychosocial variables, on percent weight change and successful weight maintenance (defined as $\leq$ 5% weight regain), after controlling for age, gender, education, income, and marital status. Descriptive statistics and group comparative statistics (*t*-tests or Mann Whitney U tests) were used to examine behavioral strategies utilized for weight

maintenance. Path analysis investigated possible mediation effects of lifestyle variables on percent weight change.

Fifty-seven percent of the 107 participants (58% of the 81 white participants and 54% of the 26 black participants) were successful weight maintainers. No difference was found in weight maintenance between racial groups; black and white individuals gained a similar amount of weight (M = 5.0%, SD = 6.6% and M = 4.4%, SD = 5.6%, respectively). An increase in barriers to healthy eating and the impact of a stressful life event on eating affected the percent weight gained and unsuccessful weight maintenance, ps < .04. Most behavioral strategies for weight maintenance were used less than half the time. Dietary intake and physical activity did not mediate the relationship between the examined psychosocial variables and weight maintenance.

A difference in weight maintenance between black and white individuals was not supported by this study. Future research should further explore the weight control barriers that individuals experience and the impact of stress on weight maintenance.

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PREFACE

I would like to sincerely thank the members of my dissertation committee for their invaluable help and support. Thank you to Dr. Lora Burke, my advisor and dissertation chair, for her tremendous encouragement, support, and mentorship throughout my years in the program. I am indebted to her for her guidance, generosity, and devotion to my success. To Dr. Lin Ewing, Dr. Marilyn Hravnak, Dr. Susan Sereika, and Dr. Kyeongra Yang, I am extremely appreciative of your willingness to share your time and expertise with me throughout the process of achieving this goal. Thank you for all of your assistance.

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Thank you to my incredibly supportive family and friends. To Mom, Dad, Amy and Brian, thank you for your constant encouragement, understanding, and love. Thank you for enduring the sacrifices necessary for me to achieve this goal. To my husband, Ed, I give my endless gratitude and love for his continuous support and unfailing belief in my abilities. Without your suggestion, I would not have achieved this accomplishment. To all of my friends, thank you for your genuine support and encouragement during this long journey.

1.0 PROPOSAL

1.1 SPECIFIC AIMS

Obesity is a pervasive, chronic health problem associated with an exceptionally high rate of recidivism (Mokdad et al., 2003; Wadden, Brownell, & Foster, 2002). Currently, 66.3% of the U.S. population is either overweight (Body Mass Index or BMI 25-29.9 kg/m^2) or obese (BMI $\geq$ 30 kg/m^2) (Centers for Disease Control and Prevention, 2007), with significant increases in the overweight prevalence among children and adolescents and obesity prevalence in men between 1999 and 2004 (Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006). Morever, racial minorities are affected in greater proportions by the problem of overweight and obesity. The overall prevalence of obesity for non-Hispanic Blacks was 45% in 2003-2004, compared to 36.8% for Mexican Americans, and 30.6% for non-Hispanic Whites (Ogden et al., 2006). Moreover, women are at higher risk (U.S. Preventive Services Task Force, 2003), especially minority women. Nearly 54% of African American women and 42.3% of Mexican American women are obese compared to 30.2% of non-Hispanic white women (Ogden et al., 2006). A major problem in obesity research is the paucity of investigations focused on racial groups who are at the most risk for obesity and its complications (Kumanyika, 1993; Kumanyika et al., 2005). While obesity researchers have succeeded over the last 20 years in enhancing the amount of weight loss achieved initially (Jeffery et al., 2000), the principal challenge in the treatment of

overweight and obesity is determining strategies that can improve long-term weight maintenance after a loss. However, prior to developing interventions to improve maintenance, we first need to understand what factors may influence successful maintenance and particularly if there are differences across racial minorities. Therefore, the purpose of this descriptive, ancillary study is to determine if there are differences between black and white persons in long-term weight maintenance after an 18-month randomized clinical weight-loss trial.

In the randomized clinical 2 x 2 design of the parent study, Paving the Road to Everlasting Food and Exercise Routines (PREFER) participants were randomly assigned to receive either their treatment preference or not. Participants indicated their preferred treatment, choosing between a low-fat, reduced-calorie lacto-ovo-vegetarian (LOV) diet or a standard low-fat, reduced-calorie diet, as part of a behavioral intervention comparing the effects of these two eating plans and treatment preference on weight loss, adherence to diet and exercise, and lipid changes. Individuals randomized to treatment Preference- Yes were assigned to their preferred diet plan. Those randomized to treatment Preference- No were then randomized to receive either the standard or LOV diet, without regard to their preference. The behavioral intervention, based on social cognitive theory, focused on strategies for changing eating and exercise habits and included 6 months of weekly meetings, 3 months of bi-weekly meetings, and 3 months of monthly meetings, for a total of 12 months (33 sessions) of active treatment; a 6-month period followed with no intervention sessions.

In this study, weight maintenance in minority persons who identify themselves as Black or African American, based on the PREFER population demographics, will be described and explored in comparison to non-minorities, those persons who identify themselves as White. For the purposes of this proposal, Black shall refer to individuals who have self-identified as Black

or African American except in the literature review where the original authors' terms for racial group are followed. This study will adopt the criteria of successful long-term weight maintenance common in the weight maintenance literature, ≤ 10% weight regain over a minimum of one year (Vogels & Westerterp-Plantenga, 2007; Wing & Hill, 2001). A weight loss of 5-10% is recommended to reduce obesity-related health risk factors (Klein et al., 2004; National Heart Lung and Blood Institute Obesity Education Initiative Expert Panel on the Identification Evaluation and Treatment of Overweight and Obesity, 1998; World Health Organization, 1997).

The primary aims are to:

1. Investigate if there are differences between black and white persons in the percentage of weight change, as well as successful weight maintenance defined as ≤ 10% weight regain, at 18 months post-completion of the PREFER study.

2. Describe the behavioral strategies utilized by black and white persons for weight maintenance after the PREFER study.

3. Examine the influence of possible predictors (self-efficacy, experiences in following a low-fat diet, barriers to healthy eating) on the percentage of weight change and successful weight maintenance as well as whether race moderates the relationship between identified predictors and weight maintenance.

The secondary aims are to:

1. Describe the impact of social support on weight maintenance for black and white persons.

2. Describe the impact of stress on weight maintenance for black and white persons.

3. Explore the roles of dietary intake and physical activity as potential mediators of the relationship between weight maintenance and 1) experiences in following a low-fat diet, 2)

barriers to healthy eating, 3) self-efficacy, 4) social support, and 5) stress.

1.2 BACKGROUND AND SIGNIFICANCE

The literature review will use terms for racial groups as used by the original authors with the recognition that individual members of minority populations may identify themselves differently.

1.2.1 Theoretical model

The framework for this study is based on Social Cognitive Theory (SCT). SCT originally developed as social learning theory (Bandura, 1977) but later became social cognitive theory to incorporate the important role of cognition in individuals' behaviors (Bandura, 1986). According to the social cognitive perspective, individuals neither are compelled by inner drives nor are they inevitably shaped and regulated by external stimuli. Instead, human action is described by triadic reciprocality, or reciprocal determinism, where, person, environment, and behavior all function as interacting influences and determinants of each other. SCT is a theoretical framework for examining human motivation, thinking, and action from a standpoint that emphasizes the reciprocal interaction of these factors (Bandura, 1986). Social cognitive theory emphasizes that the individual is a proactive and interactive entity rather than a reactive entity being molded by environmental influences (Bandura, 2001).

Because weight maintenance is a complex multi-factorial process, social cognitive theory, with the concept of reciprocal determinism, was determined to be an appropriate foundation for this research. Percentage of weight loss maintained will be affected by these

realms of influence e.g., the environmental factors of barriers to healthy eating, social support, and stress together with personal factors of race, efficacy beliefs and experiences associated with eating a low-fat diet, as well as dietary intake, physical activity, and behavioral weight maintenance strategies utilized by participants. To overcome the obstacles individuals are faced with in life, they need social supports, or resources, to supply importance and value to what they do. When social connections are insubstantial or absent, susceptibility to harmful influences is increased (Bandura, 1989). This theoretical concept suggests that persons with insufficient social support for a behavior or goal may be vulnerable to negative influences that cause weight regain.

Self-efficacy is a component of SCT and describes a person's judgments regarding the ability to execute actions needed to perform selected behaviors (Bandura, 1997). Self-efficacy highlights the vital role an individual's estimations of his/her capabilities play in behavior change, to the extent that perceived self-efficacy is a major determinant of performance independent of actual underlying skill (Bandura, 1986). Moreover, individuals are more likely to continue their efforts toward successful achievement if their perceived self-efficacy is higher (Bandura, 1982). Yet, inconsistencies have been reported regarding self-efficacy and weight management. While some have noted higher self-efficacy is associated with more successful weight loss and maintenance (Dennis & Goldberg, 1996; Richman, Loughnan, Droulers, Steinbeck, & Caterson, 2001), others have found that increased self-efficacy levels prior to treatment were associated with less weight loss in African American women (Martin, Dutton, & Brantley, 2003). These findings might indicate that a high baseline self-efficacy is a sign of overconfidence or lack of experience with the challenges of weight loss (Martin et al., 2003). Although various studies have investigated the relationship between self-efficacy and weight loss, the role of self-efficacy in weight maintenance is not well described. Linde and colleagues

reported that eating self-efficacy was predictive of weight-loss behaviors like counting calories and eating less fat, but self-efficacy was not associated with weight change during the follow-up period (2006). Conversely, other researchers have found that self-efficacy is associated with successful weight management in individuals who had been overweight in the past (Kitsantas, 2000). These findings suggest that self-efficacy during weight maintenance and potential racial differences with self-efficacy and weight control need to be explored.

The purpose of the dissertation study is to describe and explore weight maintenance for black and white persons using the theoretical foundation of SCT and reciprocal determinism, a model that explains the shared interaction between the three causal factors of person, environment, and behavior, and the mutual impact each has on the others in describing human behavior (Bandura, 1986). Figure 1.1 represents the theoretical model with variables of interest for the dissertation study based on the concept of reciprocal determinism from SCT. The three elements are represented as: 1) Person— race, self-efficacy for eating and exercise, experiences associated with following a low-fat diet; 2) Environment— barriers to healthy eating, social support, stress; and 3) Behaviors— behavioral strategies used to support maintenance of lost weight, dietary intake and physical activity.

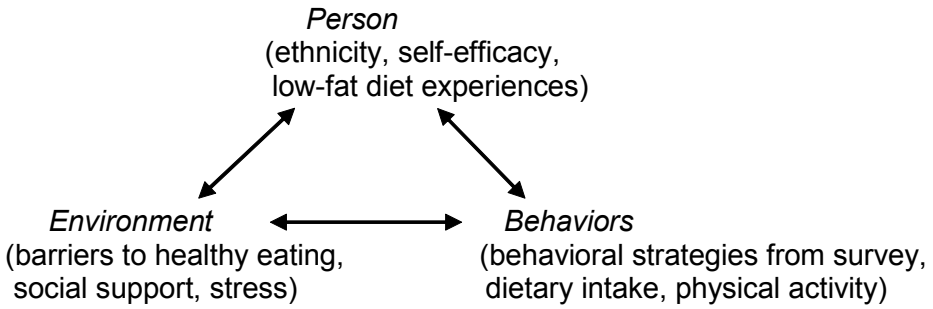


Figure 1.1: Theoretical model based upon reciprocal determinism adapted for this study

However, the interactivity of these elements will not be directly tested in this study. Thus, the conceptual framework for examining the specific aims is depicted in Figure 1.2. The dissertation study will examine self-efficacy, experiences associated with following a low-fat diet, barriers to healthy eating, social support, and stress, as well as possible mediating variables (dietary intake and physical activity) and their relationship with weight maintenance in black and white persons.

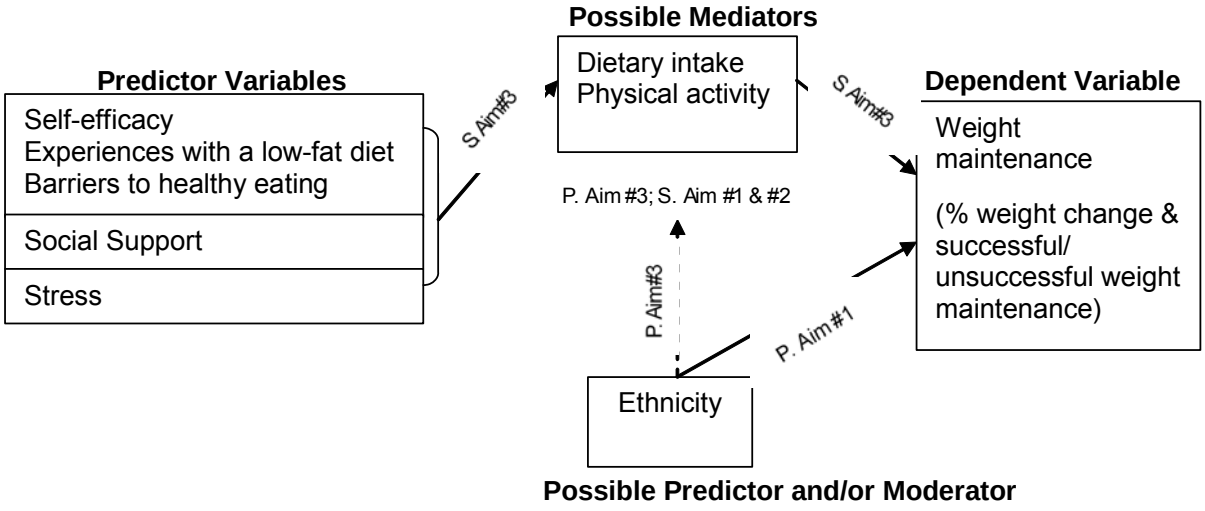
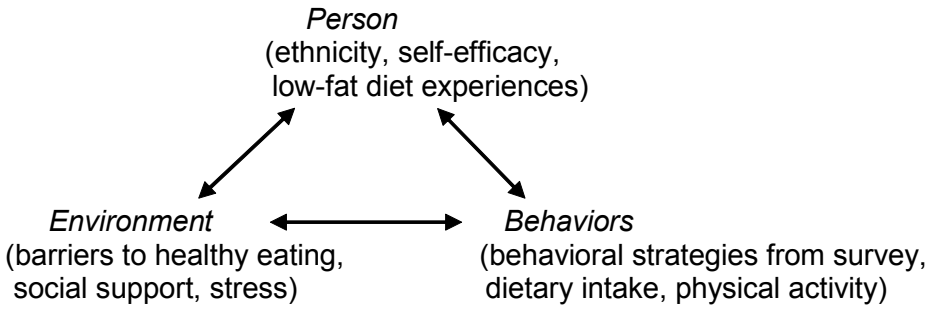


Figure 1.2: Conceptual framework



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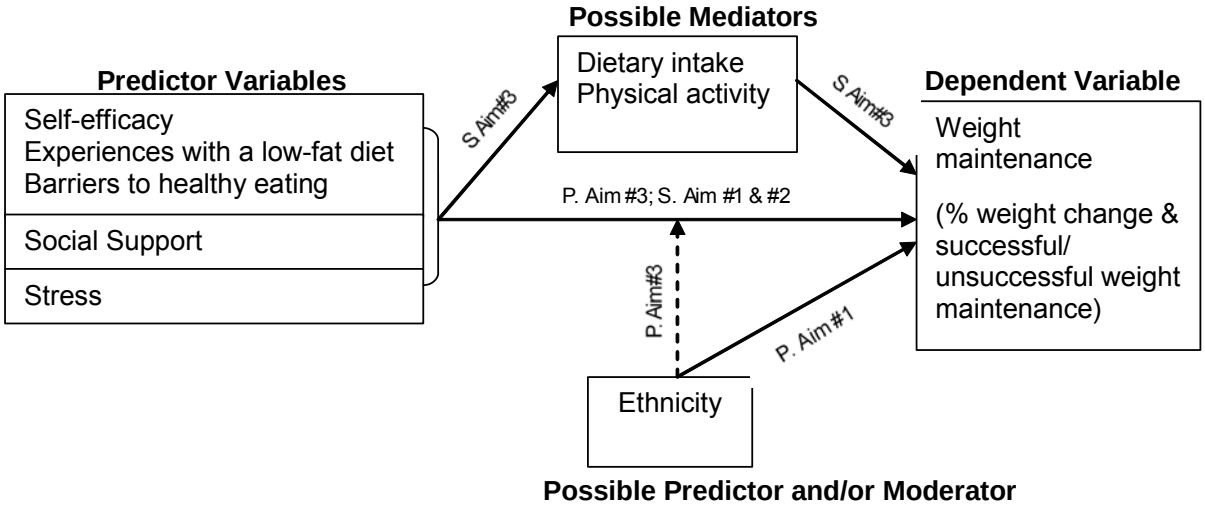

Figure 1.2: Conceptual framework

restaurants per square mile in communities with only 20% Blacks. Comparing neighborhoods of similar size, black communities had easy access to six more fast-food restaurants than mostly white neighborhoods (Block, Scribner, & DeSalvo, 2004), and 4 times as many supermarkets, with a wider variety of healthier food options, are located in white neighborhoods compared to black neighborhoods (Morland, Wing, Diez Roux, & Poole, 2002). This suggests that minority populations may not have the same opportunities in their living environment as Whites to make healthier food choices.

Psychological and physiological influences on weight maintenance have been noted as well. Psychological components contributing to weight regain include boredom (Smith, Wing, & Burke, 2000; Wing & Jeffery, 2003), unrealistic weight-loss goals (Cooper & Fairburn, 2001; Dalle Grave et al., 2005; Giusti, Suter, Heraief, Gaillard, & Burckhardt, 2003), and inadequate coping or problem-solving abilities (Drapkin, Wing, & Shiffman, 1995; Kayman, Bruvold, & Stem, 1990). A decrease in eating restraint, or eating control, and increase in disinhibition, or loss of eating control, have also been noted to play a role in weight regain after loss (McGuire, Wing, Klem, Lang, & Hill, 1999; Niemeier, Phelan, Fava, & Wing, 2007; Wing & Hill, 2001). A physiological contributor to regain is decreased metabolic rate, both in resting energy expenditure (REE) (Foster, Wadden, Swain, Anderson, & Vogt, 1999) and activity energy expenditure (AEE) (Weinsier, Hunter, Schutz, Zuckerman, & Darnell, 2002). In fact, Foster and colleagues found that black participants had significantly larger decreases in REE after calorie restriction and weight reduction than did white participants (1999). Weinsier et al. found that after weight loss, AEE and aerobic capacity significantly increased in white women, but significantly decreased in black women (2002). Others have noted significantly lower REE in African Americans compared to Whites (Chitwood, Brown, Lundy, & Dupper, 1996; Jakicic &

Wing, 1998). These findings suggest that further investigation of racial differences is warranted. While specific measurements of metabolic rate will not be performed, the dissertation study will examine, at completion of the PREFER study and 18 months post-completion, an estimation of weekly energy expenditure from leisure-time activities and in light (5 kcal/min), moderate (7.5 kcal/min), and vigorous (10 kcal/min) intensity activity using the Paffenbarger Activity Questionnaire (Paffenbarger, Wing, & Hyde, 1978).

1.3.2 Racial minorities

Minority populations are affected by some medical conditions linked to overweight and obesity at a higher rate than their white counterparts. Obesity-related diseases like diabetes, hypertension, and cardiovascular disease are more prevalent in minority persons (Cossrow & Falkner, 2004; Smith et al., 2005; Sundquist, Winkleby, & Pudaric, 2001). In 2005 in the U.S., the prevalence of type 2 diabetes among adults was greater for African Americans and Hispanics than for Whites (Centers for Disease Control and Prevention, 2005). African Americans are more likely to be obese than individuals of European ancestry (Jeffery et al., 2000). Although the risk of weight gain is common to all Americans and the greatest increase in weight occurs between ages 25 and 44, the rate of change is more acute in black women. An examination of weight change over a 20-year period found that white women aged 25 to 35 gained 7.7 kg while black women the same age gained almost 11 kg over 20 years (Sheehan, DuBrava, DeChello, & Fang, 2003). Weight reduction and maintenance are key factors in decreasing the disproportionate burden of disease in racial minority groups (Kumanyika, 2002).

Empirical findings suggest that there are differences related to weight management between black and white persons. Nies and colleagues assessed health-promoting activities in 86

obese and non-obese women and found that there were essentially no major differences between African American and European Americans in health-promoting behavior except in the area of nutrition. African American women scored lower on the nutrition subscale of the Health-Promoting Lifestyle Profile (Nies, Buffington, Cowan, & Hepworth, 1998). African American women use more commercial diet tools and participate in weight-loss behaviors for less time than white women who weigh significantly less (Tyler, Allan, & Alcozer, 1997). A reduced amount of time spent participating in weight-loss strategies may foreshadow a problem for successful weight maintenance, as necessary behaviors must be adopted for the long-term.

Researchers have noted that black women are concerned about excess weight but are not as successful in their weight management efforts as white women (Kumanyika, Obarzanek, Stevens, Hebert, & Whelton, 1991). Inconsistencies are reported related to weight loss and minorities, however. The Diabetes Prevention Trial (DPP) enrolled over a 45% representation of minority participants (19.9% African American, 15.7% Hispanic, 5.3% American Indian, 4.4% Asian) and saw a 58% reduction in diabetes with a mean weight loss of 5.6 kg. In the DPP, the lifestyle intervention was designed so that participants would achieve and maintain a weight loss of at least seven percent of baseline body weight by following a reduced-calorie, reduced-fat diet and participating in moderate intensity physical activity, like brisk walking, for a minimum of 150 minutes each week. This intervention was equally effective across all racial/ethnic groups over an average of 2.8 years (Knowler et al., 2002). Some have found that black individuals lose significantly less weight than white persons during treatment, but their regain of lost weight was either equal to or smaller than white participants (Kumanyika et al., 2002; Rickel et al., 2007). Black participants lost less weight during the first 18 months of treatment in a large trial examining weight loss and blood pressure; yet, there was no longer a difference in weight loss

between the groups at 36 months (Stevens et al., 2001), suggesting that black participants experienced better weight maintenance. A smaller trial reported that weight regain was more rapid in black participants (Wing & Anglin, 1996). Others have found that a higher proportion of black persons failed to lose ≥ 5% of their initial weight (Early et al., 2007). Insufficient research has been performed with black populations to make conclusions about weight management, in particular examining weight maintenance after loss.

Little is known about members of racial minority groups like black Americans and their weight maintenance. One randomized clinical trial and three other trials addressing weight-loss maintenance with black individuals were found (Barnes et al., 2007; Kumanyika et al., 2005; Walcott-McQuigg et al., 2002). The randomized trial, conducted in an urban university's outpatient family practice department, aimed to improve weight-loss maintenance in the two interactive, culturally-oriented intervention arms (group meetings and staff-assisted self-help) compared to the usual care group, but found no difference between the groups in amount of regain. While the participants regained a nonsignificant mean of 0.3 kg (95% CI, -0.6 to 1.3 kg), the total weight loss from the beginning of the weight-loss phase was only 1.2 kg (95% CI, -0.1 to 2.3 kg) (Kumanyika et al., 2005). Findings from a weight-loss trial with 23 African American women, 10 of whom completed the weight-maintenance phase, revealed that a lower response to hunger and eating cues were marginally related to weight-loss maintenance, $p = .057$ (Walcott-McQuigg et al., 2002). Two qualitative studies used focus groups with African American women to try to understand elements related to weight-loss maintenance. Barnes et al. noted the importance of encouragement from others as well as dealing with practical matters like hairstyle disarrangement during exercise (2007). Others reported motivations for weight-loss maintenance

that included looking better in properly-fitted clothing and feeling better about their appearance (Young, Gittelsohn, Charleston, Felix-Aaron, & Appel, 2001).

Racial differences appear to exist in the perception of an ideal body image and preference for body size. Greenberg and LaPorte surveyed 63 African American and 116 European American men and asked them to rank a sequence of different-sized female silhouettes in order of most desirable. European American men selected significantly slimmer figures and stated they hoped their girlfriends would lose weight significantly more frequently than African American men (1996). Self-perception also appears to differ between black and white women. Duncan et al. found that black, inactive women did not feel their weight, physical appearance, fitness, or eating behaviors were any worse than their white counterparts despite the fact that they weighed more, were not as fit, and had a higher percentage of fat in their diet (2003). Other studies have reported that black women have higher levels of body satisfaction at a larger body size (Baturka, Hornsby, & Schorling, 2000; Wolfe, 2000). Some research, however, questions the link to body size preference and race. A study of black and white female dieters in mid to high socioeconomic classes (mean annual income between $50,000- $59,999) found no significant differences in discontent with body size between minority and non-minority women; these authors suggest that previously reported racial differences may have been due to socioeconomic status rather than weight (Caldwell, Brownell, & Wilfley, 1997).

Because research in long-term weight maintenance is lacking (Jeffery et al., 2000) and little empirical evidence exists from the few studies that investigated this issue in minority populations, the dissertation study will fill an important gap in the literature by exploring any differences that may exist between black and white persons in weight maintenance after a behavioral weight-loss trial.

1.3.3 Low-fat diet experiences

Research has focused on sustaining a diet low in fat as a method for promoting weight maintenance (Astrup, Grunwald, Melanson, Saris, & Hill, 2000; Lindstrom et al., 2006; Shick, Wing, Klem, McGuire, Hill, & Seagle, 1998; Swinburn, Metcalf, & Ley, 2001), but following a low-fat diet may be more difficult in the long term. High-fat foods are often considered more palatable. This palatability and lack of satiating ability (Astrup, Toubro, Raben, & Skov, 1997) have the potential to lead to overconsumption and a greater caloric intake (Bray, Paeratakul, & Popkin, 2004). In addition, individuals report feeling deprived when eating a diet low in fat (Urban et al., 1992). A study comparing the efficacy of a low-calorie diet without fat restriction to a diet limiting fat intake found similar weight losses between the two groups during treatment, and long-term weight-loss maintenance was not different between the groups, suggesting that adherence to one diet was not improved over adherence to the other (Jeffery, Hellerstedt, French, & Baxter, 1995). Others have found that improved long-term weight losses may actually result from a moderate-fat diet compared to a low-fat diet (Azadbakht, Mirmiran, Esmaillzadeh, & Azizi, 2007; McManus, Antinoro, & Sacks, 2001) and that dietary adherence to a moderate-fat diet may be less difficult, resulting in better maintenance outcomes. Yet, a distaste for fat has been noted to develop in those who are adherent to a low-fat diet, promoting the continuation of the diet long-term (Urban et al., 1992). It is imperative to understand what individuals experience when following a low-fat diet in order to determine how to best promote maintenance of lost weight. Additionally, the experiences of black persons related to following a low-fat diet have not been specifically documented.

1.3.4 Barriers

Multiple barriers to weight management exist in the areas of physical activity (Fulkerson, French, Story, Hannan, & Neumark-Sztainer, 2004; Jakicic, 2003) and dietary intake (Eikenberry & Smith, 2004; Vijan et al., 2005). A weight-maintenance investigation of barriers associated with physical activity and healthy food intake in women aged 18-32 years found the main barriers to healthy eating were concerns about taste, insufficient time, and motivation, and the belief that healthy foods cost more; principle barriers to physical activity were lack of time and motivation and exercise facilities that were too expensive (Andajani-Sutjahjo, Ball, Warren, Inglis, & Crawford, 2004). The PREFER investigation found that change scores in the Barriers to Healthy Eating Scale (decreases in barriers) were significantly correlated with weight loss at 6 months (Burke, Styn, Elci, Music, & Warziski, 2007). Barriers for weight loss in African American women include the cost associated with healthy foods and exercise participation (Davis, Clark, Carrese, Gary, & Cooper, 2005; Eyler, Baker, Cromer, King, Brownson, & Donatelle, 1998), as well as traditionally-prepared cultural foods and eating expectations of family members (Airhihenbuwa, Kumanyika, Agurs, Lowe, Saunders, & Morssink, 1996; Carter-Edwards, Bynoe, & Svetkey, 1998). Barriers to healthy eating for weight maintenance need to be further explored in minority populations who likely have more obstacles to overcome, e.g., higher prevalence of fast food restaurants and fewer supermarkets in communities with a high proportion of minority persons (Block et al., 2004; Morland et al., 2002).

1.3.5 Social support

Social support, relationships intended to provide positive strength to the recipient (Peterson & Bredow, 2004), is an identifiable influence on behavior (Steptoe, Wardle, Pollard, Canaan, & Davies, 1996). Some studies have reported improved outcomes in dietary modification and weight-loss treatment (Kelsey, Earp, & Kirkley, 1997; McLean, Griffin, Toney, & Hardeman, 2003; Verheijden, Bakx, van Weel, Koelen, & van Staveren, 2005), and some descriptive findings indicate that social support is important for successful maintenance (Elfhag & Rossner, 2005; Kayman et al., 1990). However, social support in weight maintenance has been largely unexplored. Wing and Jeffery examined the influence of social support on both weight loss and maintenance and found that recruiting participants with friends and increasing social support was of significant benefit. Among those recruited alone and assigned to standard behavioral treatment only, 76% completed the 4-month treatment, and 24% maintained their lost weight after 6 months. In contrast, in the group recruited with friends/family and assigned to standard treatment with social support added, 95% completed treatment and 66% maintained their lost weight at 6 months post-intervention. Notably, participants in the added social support groups received financial incentives for maintaining 100% of their lost weight, and the findings of this study might be confounded by that aspect (Wing & Jeffery, 1999). In the African American community, because of a cultural pressure to be accepting of one's body, obese women had conflicting feelings about body image and weight and thought that they did not have the social support necessary for weight loss (Baturka et al., 2000; Walcott-McQuigg et al., 2002). A comparison of perceptions and behaviors associated with diet and physical activity in urban African American women and rural Caucasian women found that rural Caucasian women stated they had more social support for changing their behaviors (Nothwehr, 2004). Alluding to the

important role of social support, married participants lost more weight than those who were single in a weight-loss study including only African Americans (Kumanyika et al., 2005).

1.3.6 Stress

Stress has been shown to have a significant impact on weight management and eating behaviors (Crowther, Sanftner, Bonifazi, & Shepherd, 2001; DePue et al., 1995). Korkeila and colleagues found that a high stress level at baseline was predictive of weight gain over a 6-year time frame (1998). Low levels of stress were associated with weight-loss maintenance in men (Sarlio-Lahteenkorva, Rissanen, & Kaprio, 2000). The physiologic effects of stress have been documented by increased levels of cortisol (Koo-Loeb, Costello, Light, & Girdler, 2000), which can increase hunger and eating (Newman, O'Connor, & Conner, 2007; Tataranni, Larson, Snitker, Young, Flatt, & Ravussin, 1996). Women who react to stress with high cortisol secretion were found to not only eat more while recovering from stress, but also choose sweet foods (Epel, Lapidus, McEwen, & Brownell, 2001). Stress-induced cortisol secretion is also associated with central body fat deposition (Epel et al., 2000; Gluck, Geliebter, & Lorence, 2004), a known cardiovascular risk factor (Bjorntorp, 1997). Physical responses to stress — heart rate and blood pressure — were measured after mentally challenging tests in 22 older African Americans, and researchers found that those with more central body fat had significantly greater heart rate and blood pressure increases than those with a smaller waist circumference (Waldstein, Burns, Toth, & Poehlman, 1999). A mixed methods investigation of 36 African American women found that women who were more overweight had higher stress levels, and more than half felt that stress negatively impacted their weight management behavior (Walcott-McQuigg, 1995). Others have investigated chronically-stressed caregivers of Alzheimer's patients compared to age-matched

controls and found that 31% of caregivers had a marked increase in weight (≥ 1 BMI unit) over 15 months compared to 11% of control participants with a marked increase (Vitaliano, Russo, Scanlan, & Greeno, 1996).

1.3.7 Dietary intake

Research findings indicate that dietary behaviors of racial minorities may differ from those of non-minorities including an increased intake of fat and calories (Haire-Joshu, Brownson, Schechtman, & Nanney, 2001; Oster & Thompson, 1996) and decreased intake of sources of fiber, such as fruits and vegetables (Jen, Brogan, Washington, Flack, & Artinian, 2007; Satia-Abouta, Galanka, Potter, Ammerman, Martin, & Sandler, 2003; Zenk et al., 2005). A cholesterol screening and education study of dietary intake related to fat consumption found that Whites had the lowest fat diet, as measured by the Food Habits Questionnaire, followed by Hispanics and then Blacks. Additionally, black and Hispanic participants were more likely to fry foods than white participants, and Hispanics were least likely to read food labels, which would increase awareness of calorie and fat content (Gans, Burkholder, Risica, & Lasater, 2003). An investigation of food preferences among three generations of black and white women found that black participants significantly preferred foods such as pancakes, grits, fried meat, french fries, cheese sandwiches, and fruit pies than did their white counterparts. This study also found that the preferences of the third generation of black women related more to their previous two generations than with the third generation of white participants (Dacosta & Wilson, 1996). These cultural differences may play an intricate role in weight maintenance for minority populations.

1.3.8 Physical activity

Many studies have reported the need for increased physical activity to maintain weight loss (DePue, Clark, Ruggiero, Medeiros, & Pera, 1995; Schoeller, Shay, & Kushner, 1997; Votruba, Horvitz, & Schoeller, 2000; Wadden, Vogt, Foster, & Anderson, 1998; Wier, Ayers, Jackson, Rossum, Poston, & Foreyt, 2001). Routine physical activity is one of the best predictors of continued weight maintenance after weight loss; moreover, regular physical activity decreases cardiovascular disease risk and increases quality of life in many overweight persons (Lavie & Milani, 1997; McInnis, 2000; Penedo & Dahn, 2005). Rather than only scheduled exercise, physical activity experts advocate increases in activity during daily life routines, such as increased walking or stair climbing (U.S. Department of Health and Human Services, 1996). Recommendations for overweight and obese persons include gradually increasing moderate intensity physical activity to at least 150 minutes per week, but for long-term maintenance of weight loss, 200-300 minutes per week should be achieved (Jakicic et al., 2001). In fact, updated recommendations from the American College of Sports Medicine and American Heart Association specify that in order to prevent weight regain, persons should engage in 60-90 minutes of moderate-intensity physical activity each day (Haskell et al., 2007; U.S. Department of Health and Human Services, 2005). Fortunately, research has demonstrated that activity can be accumulated throughout the day rather than performed in one continuous period and remain beneficial for weight management and fitness (Jakicic, Winter, Lang, & Wing, 1999). A recent study of weight-loss maintenance one year after a behavioral weight-loss intervention reported that 80% were successful at maintaining at least 5% of lost weight, but 44% of the maintainers reported between 1-30 minutes of daily activity and only 23% reported between 31-60 minutes of daily activity. The maintainers did consume an average of 384 fewer daily calories, suggesting

that weight maintenance might be achieved without meeting physical activity recommendations by reducing caloric intake (Cox et al., 2007).The dissertation study will examine physical activity as a potential mediator of long-term weight maintenance.

1.4 PRELIMINARY STUDIES

The PI has conducted research with the PREFER data to learn more about the sample population and areas of interest in the dissertation study including self-efficacy and potential differences weight maintenance between minorities and non-minorities. She has also participated in research examining barriers to healthy eating, the experiences associated with following a low-fat diet, the eating habits of individuals interested in weight-loss treatment, adherence to the weight-loss treatment protocol, differences in binge eating scores, self-monitoring diet and exercise, and the effect of treatment preference and the LOV diet on weight loss. Findings from studies pertinent to the variables in this proposal are summarized below. Related publications are listed after the study summaries. The published paper on self-efficacy, dietary adherence, and weight loss (Study 1) is included in Appendix A.

1.4.1 Study 1. The impact of changes in self-efficacy and adherence on weight loss

The PI conducted a secondary analysis to evaluate the influence of self-efficacy for resisting eating and dietary adherence on weight change over time in the PREFER study. The purpose was to determine whether an increase in self-efficacy and higher dietary adherence were associated with weight loss, and whether self-efficacy remained associated with weight loss after

controlling for dietary adherence. The mean weight loss at 18 months was approximately 5% of baseline weight and the mean increase in self-efficacy was nearly 12%. Self-efficacy, based on the total score of the Weight Efficacy Lifestyle (WEL) Questionnaire, improved over time (p = .04) and was associated with weight loss (p = .02), with the greatest increase in self-efficacy occurring at 6 months, the time point of the largest mean weight loss. Fat gram adherence was associated with weight loss (p < .001), and self-efficacy remained associated with weight loss after controlling for fat gram adherence over time (p < .001). In addition, an examination of the five subscales of the WEL revealed that all subscales were associated with weight loss, ps < .006.

Implications for this proposal: This secondary analysis allowed the PI to examine the relationship of self-efficacy for resisting eating with weight loss in the sample of participants for the dissertation study. This study increased the PI's knowledge related to a potential predictor of weight maintenance, self-efficacy, as measured by the instrument to be used, the WEL. It required the use of advanced statistical techniques, mixed effects modeling, and allowed the PI to perform preliminary data screening and analytic techniques in preparation for the dissertation analysis. It also exposed the PI to the rigorous standards of publishing manuscripts and the persistence needed to achieve publication. The finding that self-efficacy was related to weight loss over time supports the investigation of self-efficacy as a predictor of weight-loss maintenance.

Warziski, M., Sereika, S.M., Styn, M.A., Music, E., Burke, L.E. (2008). Changes in self-efficacy and dietary adherence: The impact on weight loss in the PREFER study. *Journal of Behavioral Medicine*, *31*, 81-92.

1.4.2 Study 2. Weight-loss maintenance for minorities and non-minorities during PREFER

The PI conducted a secondary analysis of 12- to 18-month weight changes during the 6-month, no-contact maintenance period of the PREFER study to determine if there were differences in weight-loss maintenance between minority and non-minority participants. The sample, consisting of participants who had weight data for the 12- and 18-month assessments (N = 124, non-minorities n = 87, minorities n = 37), was mostly female (86%) with a mean age of 44.8 years (SD = 8.4) and 15.4 (SD = 2.6) years of formal education. Sociodemographic variables (age, gender, education, income) and baseline weight were not different between the minorities and non-minorities, ps > .05. There was no difference in absolute weight change in kilograms (p = .93) or percent weight change between the two groups during the 12- to 18- month maintenance phase (p = .82). At 18 months, minorities had regained a mean (SD) of 3.7% (3.9%) of their 12-month weight, and non-minorities had regained a mean 3.3% (4.1%).

Implications for this proposal: This analysis resulted in pilot data for the sample size analysis and effect sizes computations for the dissertation study. It allowed the PI to examine the primary variable of interest, weight-loss maintenance between minorities and non-minorities, during a shorter time interval, and to explore sociodemographic variables in the sample. While these data suggest that a difference in maintenance might not exist, they only provided information for a 6-month period while participants were actually still enrolled in the PREFER study, and conclusions cannot be drawn about maintenance at the 18-month time point of the dissertation study.

Warziski, M., Sereika, S.M., Styn, M.A., Elci, O.U., Burke, L.E. (2007). Does weight-loss

maintenance differ for minorities compared to non-minorities? *Circulation*, *115*(Suppl. 8), e243.

1.4.3 Study 3. The impact of barriers to healthy eating on weight loss

The scores from the Barriers to Healthy Eating Scale were examined in the PREFER study to determine if reported barriers influenced weight loss over time. Total scores and subscale scores (emotions, daily mechanics of following the eating plan, social support) were examined as correlates of weight loss at 6, 12, and 18 months. The emotions and daily mechanics subscales as well as the total score decreased significantly at 6 months, which coincided with the time point of the largest weight loss. Nonsignificant increases in barriers were observed at 12 and 18 months. Analysis revealed that a significant relationship existed between a decrease in reported barriers to healthy eating and weight loss over time, $p < .01$.

Implications for this proposal: This study revealed that barriers to following a healthy eating plan were associated with weight loss in the parent study and supports examining this variable as a predictor of long-term weight maintenance. Because a slight increase in barriers was noted during the 12-18 month maintenance period of PREFER, this finding might suggest an increase in barriers will be observed at the dissertation study time point and could impact weight regain.

Burke, L.E., Styn, M.A., Elci, O.U., Music, E., Warziski, M. (2007). How do barriers to healthy eating impact weight loss? *Circulation*, *115*(Suppl. 8), e246.

1.4.4 Study 4. The influence of experiences following a low-fat diet on weight loss

The purpose of this study was to investigate participants' experiences while following a low-fat diet and determine if there were differences between the standard and vegetarian diet groups in the PREFER study as well as to examine the relationship with weight change. The Experiences Associated with Following a Low-Fat Diet Scale (ELF) was first administered in the PREFER study at the 6-month time point, rather than at baseline, after the participants had been following the assigned diet. The total scores as well as the scores for the subscales wellness and distaste decreased significantly over time for the total sample (*p*s < .03), and the wellness score decreased significantly more in the standard diet group at 12 months. The total ELF score significantly predicted weight change at each time point, (*p*s = .001 to .05).

Implications for this proposal: This preliminary study used the same instrument that is included in the dissertation study and reported that a relationship exists between dietary experiences when consuming a low-fat diet and weight loss. Through the analysis, the PI was involved in the details related to coding and scoring this instrument. Although the total score was predictive of weight loss in the parent study, these results suggest that positive experiences associated with eating low-fat foods decrease over time and are supportive of exploring this variable in the maintenance of weight loss.

Burke, L.E., Styn, M.A., Elci, O.U., Sereika, S.M., Music, E., Warziski, M. (2007). Experiences following a low fat diet influence dietary maintenance. *Annals of Behavioral Medicine*, *33* (Suppl.), S186.

1.5 RESEARCH DESIGN AND METHODS

1.5.1 Introduction

The dissertation study will employ a prospective, descriptive design to explore the factors related to weight maintenance after an 18-month behavioral weight-loss intervention, the PREFER study. Participants who complete the final assessment of the PREFER study will be recruited to participate in an investigation of weight maintenance. Sixteen months after completing the parent study, participants will be sent letters asking them to complete six questionnaires and return for one additional appointment to obtain their weight as measures of a long-term follow-up to the PREFER study. Persons may be uncomfortable returning if they have gained weight so an emphasis will be placed on the interest of exploring influencing factors related to weight management. Dr. Stephen Thomas, Director of the Center for Minority Health, will provide guidance in developing culturally sensitive messages to ensure a high rate of return for minority participants.

1.5.2 Description of the Parent Study

In the PREFER study, 182 participants were recruited in three cohorts, stratified on race and gender, and randomized to treatment Preference-Yes or treatment Preference-No. Those randomized to treatment Preference-Yes were assigned to their preferred diet plan (standard fat- and calorie-restricted or standard fat- and calorie-restricted diet + LOV); those randomized to treatment Preference-No were then randomized again to the standard diet or the LOV diet. During the 12-month active intervention, participants maintained weekly food and physical

activity records and weights were measured at each intervention session; a 6-month maintenance period followed with no sessions. Participants in PREFER were mainly female (87.4%) and white (70.5%) with an average age of 44.1 years (range 20-55 years) and an average BMI of 33.94 kg/m^2 (range 26.7-42.6 kg/m^2). Each treatment group received the same behavioral intervention and followed a calorie-restricted (1200 kcal for those weighing < 200 lbs and 1500 kcal for ≥ 200 lbs) and fat-restricted (25% of daily calories) diet for 18 months; the lacto-ovo-vegetarian group eliminated all meat, fish, and poultry over the first 6 weeks. Baseline, 6-, 12-, and 18-month physical assessment measures included weight, BMI, waist circumference, serum collection for lipid profile, glucose, and insulin. Paper-and-pencil measures, administered at 6, 12, and 18 months, included a Three-Day Food Diary, Paffenbarger Activity Questionnaire, Barriers to Healthy Eating, Hunger Satiety Scale, Weight Efficacy Lifestyle Questionnaire, Beck Depression Inventory-II, and Medical Outcomes Questionnaire, Short Form-36. The Experiences Associated with Following a Low-Fat Diet is first administered at the 6-month assessment, rather than baseline, after the participant has been exposed to a reduced-fat diet.

1.5.3 Eligibility Criteria

The eligibility criteria for the dissertation study are dictated by the selection criteria of the PREFER study; participants were 18-55 years old at enrollment of the PREFER study, agreeable to randomization to their treatment preference or not and one of the two diet plans, had a BMI between 27 and 43 kg/m^2, inclusively, and had adequately completed a 5-day food intake diary. The age range was chosen to ensure an adult population that was young enough to have a limited occurrence of comorbidities, such as osteoarthritis, that might prohibit participation in physical

activity. For the dissertation study, participants must also have completed the final 18-month assessment of the PREFER study.

1.5.4 Recruitment

At the final assessment of the PREFER study in the end-of-study survey, most participants indicated an interest in participating in future investigations. Former PREFER participants will be recruited to participate in the dissertation study of weight maintenance. Because the PI has been working as a member of the PREFER study research team, a relationship with the participants has developed and recruitment will be by an individual known to them. Eligible participants will receive a letter from the PI of the PREFER study and the PI of the dissertation study, and a consent form approximately 16 months post-completion of the PREFER study. While 16 months is a long time, contact with participants has been maintained by the PREFER study through birthday and holiday cards; participants also received their laboratory results 2 months after the study's completion. The letter will explain the interest in exploring the factors involved in weight maintenance and ask that they return for one assessment. To encourage participants who may be reluctant to respond because they have gained weight, the letter will stress the interest in examining variables related to weight management regardless of current weight. The purpose of learning about weight maintenance and how to better assist persons in this endeavor will be emphasized. See Appendix E for the letter. Interested participants will be asked to call for more information. During the phone call, the study will be explained to the participant, and the person will be asked if he/she has any questions about the consent form. See Appendix D. Consent forms will be returned by mail and participants will be mailed the questionnaires and contacted to schedule an appointment for their weight after the consent form

is received. A copy of the consent form will be given to the participant at their appointment. Written informed consent will be obtained, per the protocol of the Institutional Review Board (IRB) at the University of Pittsburgh, to allow the use of secondary data from the PREFER study as well as to collect additional measures. If persons are unable to return to Oakland, the PI will discuss alternative means to obtain their weight such as traveling to their place of business, home, or another mutually agreed upon location. As a last resort, for persons who absolutely cannot meet in person, the PI will obtain a current, self-report weight. Self-reported weights have been used in the National Weight Control Registry since 1994 (Wing & Hill, 2001) and have been shown to be accurate by others (Kuczmarski, Kuczmarski, & Najjar, 2001; Must, Willett, & Dietz, 1993; Palta, Prineas, Berman, & Hannan, 1982). Participants will be compensated for their time with a gift certificate to a regional grocery store chain. The PREFER study had a 76% retention of participants at the final assessment (N = 132, non-minorities n = 92, minorities n = 40). Due to the high retention of the PREFER study and because the population of Pittsburgh tends to be stable with persons maintaining their residency, the projected loss of participants for the dissertation study is an additional 10% beyond that of the PREFER study. Based on PREFER study retention, a projected recruitment of 119 participants is expected, maintaining the 29.5% minority composition (84 non-minorities, 35 minorities).

1.5.5 Measurement of Dependent Variable (Instruments are located in Appendix C):

All measurements will be conducted at one time point at the outpatient department of the Clinical and Translational Research Center at Montefiore University Hospital or the School of Nursing in a private room. If participants are unable to travel to Oakland, arrangements will be made to meet the participant at an agreeable, convenient location, e.g. their home, work place.

As a last resort, for participants who are absolutely unable to meet in person, we will obtain a self-reported current weight, which has been shown to be valid in previous studies of middle-aged adults (Kuczmarski et al., 2001; Spencer, Appleby, Davey, & Key, 2002). Often a 2 kg correction is added to self-reported weights to account for potential under-reporting (Kramer, Jeffery, Snell, & Forster, 1986; Linde, Jeffery, Finch, Ng, & Rothman, 2004; Palta et al., 1982), and this correction will be added to self-reported weights in the dissertation study.

Weight change. % weight change from completion of the PREFER study to 18 months post completion will be the primary dependent variable and calculated as follows:

$$\frac{\textit{weight at 18 months - PREFER study completion weight}}{\textit{PREFER study completion weight}} \times 100 = \% \Delta \text{ weight } (\textit{weight change})$$

The Tanita Scale and Body Fat Analyzer will be used to measure weight in pounds with participants wearing light clothing and standing bare foot on the scale's footpads. The Tanita uses leg-to-leg bioelectrical impedance analysis to measure body composition and has been validated with underwater weighing and seven skinfold measures (Powell et al., 2001).

1.5.6 Measurement of Potential Mediators

Dietary intake. In place of the 3-Day Food Diary used in the PREFER study, two unannounced 24-hour dietary recalls will be conducted for two reasons. The recall is less burdensome for the participant than completing the food diary, and the recall is the most robust method for collecting dietary intake data (Conway, Ingwersen, & Moshfegh, 2004; Freedman et al., 2004). The two recalls will include a nonconsecutive workday and non-working day that preferably are

representative of their typical food intake. The interviewer will use the Nutrition Data System Research (NDSR) software, which prompts a thorough review of foods eaten in the previous 24 hours. Participants will be instructed on how to complete the dietary recall and will be provided measurement references for use during the interview to help them judge their portion sizes. Participants will be told to expect a call twice within the two weeks prior to or following the assessment. The NDSR software is maintained by the Nutrition Coordinating Center at the University of Minnesota (Buzzard, Schakel, & Ditter-Johnson, 1995), contains over 18,000 foods, 8000 brand name products, a number of ethnic foods and is updated twice a year to include new foods and data. The dietary data obtained from the PREFER study via 3-Day Food Diaries were also analyzed using this same nutrient software. An average kilocalorie (kcal) and fat gram intake of the two days will be derived.

Physical activity. The Paffenbarger Activity Questionnaire (PAQ) will be used to measure physical activity (Paffenbarger et al., 1978) and asks participants about their usual activities for the past week. It provides an estimation of kcal expenditure through the assessment of leisure-time activities e.g., daily city blocks walked, number of flights of stairs climbed, total minutes of sports or recreational activities. In the scoring of the PAQ, one city block = 8 kcal, one flight of stairs = 4 kcal, and sports or recreational activities are assigned a metabolic equivalent or MET value based upon intensity. A MET is defined as the ratio of an individual's working metabolic rate relative to the resting metabolic rate. One MET is equal to 1 kcal per kg per hour and is the caloric consumption of a person while at total rest (Ainsworth et al., 1993). Example MET values include light intensity = 5 kcal/min, moderate intensity = 7.5 kcal/min, and vigorous intensity = 10 kcal/min ("Paffenbarger Physical Activity Questionnaire: A collection of

physical activity questionnaires for health related research," 1997). A total weekly score for energy expenditure in kcals is derived from the equation:

(*blocks/day x 8 kcal/block x 7 days/week*) + (*flights of stairs/day x 4 kcal/lfight x 7 days/week*) + (*MET value for recreational activity x occasions/week x minutes/occasion*) = *Total kcal/week*

This instrument has shown good test-retest reliability (r = .34 to .72); validity has been reported as r = .29 with Caltrac Physical Activity Monitors and r = .62 with VO2 max (Ainsworth et al., 1993).

1.5.7 Measurement of Predictor Variables

Experiences Associated with Following a Low-Fat Diet (ELF). This questionnaire is a 25-item scale developed and used in the Women's Health Trial (Urban et al., 1992) and measures experiences believed to be related to dietary maintenance. Of the 6 factors in the scale, two are indicators of experiences associated with maintaining a low-fat diet— *wellness* (feeling healthier while on the diet) and *distaste* (for fat). The remaining four factors are believed to inhibit maintenance— *cost* (time and money), *inconvenience* (adhering to the diet when not eating at home), *deprivation* (denied desired foods), and *family* (insufficient support from family). It has a 5-point scale (1 = strongly disagree to 5 = strongly agree) and was validated during the Women's Health Trial (r = .26 to .76). Negatively worded items are reverse coded so that higher scores represent a more positive experience. The PREFER study's psychometric analysis showed Cronbach's alpha to be .83 in a sample of predominantly middle-aged women (Kim, Burke, Music, Cartwright, Polakoski, & Tschirpke, 2004).

Barriers to Healthy Eating (BHE). This scale is a 22-item questionnaire in which participants rate various circumstances related to following the healthy eating plan (emotions,

daily mechanics of following the eating plan, social support) on a scale of 1 (no problem) to 5 (very important problem). Lower scores indicate fewer barriers. This scale was used in a previous weight-loss study (Jeffery et al., 1993) but was expanded by the PI of the PREFER study and psychometric testing using a sample of mostly women of middle age revealed a Cronbach's alpha of .86; test-retest reliability across four time points was acceptable with an intraclass correlation of .89 (Burke, Kim, & Music, 2004).

Weight Efficacy Lifestyle (WEL) Questionnaire. This instrument is a 20-item measure to assess self-efficacy for weight management (Clark, Abrams, Niaura, Eaton, & Rossi, 1991). This scale assesses one's confidence in the ability to resist eating in different situations on a scale of 0-9, with higher scores indicating higher confidence. The five subscales include availability, negative emotions, physical discomfort, positive activities, and social pressure. Psychometric properties are well-established in samples of over 70% women in their early 40's with Cronbach alpha coefficients ranging from .70 to .90 (Clark et al., 1991). The validity and reliability of the instrument has also been established in middle-aged African American women (Dutton, Martin, Rhode, & Brantley, 2004). The pilot study conducted by the PI using this instrument found that self-efficacy was significantly associated with weight loss (Warziski et al., 2007).

Self-Efficacy for Exercise (SEE) Scale. This questionnaire, not administered during the PREFER trial, is a 9-item self-efficacy measure for exercise (Resnick & Jenkins, 2000) that asks persons to rate their confidence in their ability to exercise 3 times per week for 20 minutes given a variety of circumstances. Good internal consistency with a sample of older, predominantly female adults (mean age = 85 years) has been reported with Cronbach's alpha = .92; construct and criterion-related validity have been supported as well (Resnick & Jenkins, 2000). The scale range is 0 (not confident) to 10 (very confident), and the measure is scored by totaling the

response rating for each item and dividing by the number of items answered with higher scores indicating greater confidence. Successful weight-loss maintainers have been shown to have significantly greater confidence in the ability to exercise (Riebe et al., 2005; Teixeira et al., 2004).

Behavioral Strategy Survey (BSS). This scale is a 20-item questionnaire constructed for the dissertation study to assess strategies utilized (or not) for weight maintenance. It asks about standard behavioral strategies taught during the PREFER study intervention such as self-monitoring of food intake and physical activity, increasing physical activity, portion control, eating and assertiveness, label reading, recipe modification, monitoring eating and exercise cues in your environment, problem-solving for high-risk situations, negative thoughts, stress management, and relapse prevention. Each question asks the participant to estimate, on a 0-100% scale, what percent of the time in the last 18 months the strategy was used. This survey was not administered during the PREFER trial but was pilot tested in a group of women being counseled for weight loss who reported that it was easily completed. See Appendix C.

Social support. In order to reduce subject burden and avoid adding additional instruments, the first secondary aim exploring social support will be assessed using three items from the Barriers to Healthy Eating Scale and four items from the Experiences Associated with Following a Low-Fat Diet Scale that measure family and friend social support. Each instrument uses a five-point scale and a composite score will be calculated for social support. One item in the Behavioral Strategy Survey asks about social support for healthy eating and physical activity as well.

Stress. The second secondary aim examining stress will be assessed in the Behavioral Strategy Survey, which inquires about stressful life events, how stress affects eating habits, and

stress management techniques. This variable was not measured in the PREFER study and data will serve as a concurrent predictor of weight maintenance.

With the exception of the WEL questionnaire, these instruments have not been specifically tested for psychometric properties among black persons, but have been tested with samples that included black participants.

Table 1.1: Time Points for Assessment of Variables of Interest

Variable	Completion of PREFER	Dissertation Study
Weight	X	X
Dietary intake	X	X
Physical activity	X	X
BHE	X	X
ELF	X	X
WEL	X	X
SEE		X
BSS		X
Social support	X	X
Stress		X

Note. BHE= Barriers to Healthy Eating Scale; ELF= Experiences Associated with Following a Low-Fat Diet Scale; WEL= Weight Efficacy Lifestyle Scale; SEE= Self-Efficacy for Exercise Scale; BSS= Behavioral Strategy Survey

1.5.8 Procedures

Participants will be mailed questionnaires after they have returned the consent form and asked to bring the completed paper work with them to the assessment appointment. Questionnaires will be reviewed for missing data and any ambiguous responses will be clarified. If the participant forgets the questionnaires, they will be completed at the assessment appointment. This protocol was followed in the PREFER with successful collection of data. All questionnaires for the dissertation study were administered during the PREFER study with the exception of the Self-Efficacy for Exercise Scale and the Behavioral Strategy Survey. Questionnaires will be in Teleform format and scanned using Teleform Elite (version 8.2, Verity, Inc., Sunnyvale, CA), a Windows-based software package for automated data entry/verification (Davidson, Ryan, Rohay, & Sereika, 1996). Questionnaire forms will be pre-coded to help decrease coding error during data entry; range checking and data cleaning will be performed prior to analysis.

Table 1.2: Dissertation Study Timeline for Questionnaire Administration, Assessment of Weight and Dietary Intake

	Cohort 1	Cohort 2	Cohort 3
PREFER Study Completion	Aug. 2004	Feb. 2005	Aug. 2005
Dissertation Study Data Collection	Feb. 2006	Aug. 2006	Feb. 2007

1.6 DATA ANALYSIS PLAN

1.6.1 Preliminary Data Analysis

A detailed descriptive analysis of all data collected will be performed involving the summarization of data and the use of inferential and graphical exploratory data analytic techniques. The information obtained from this preliminary investigation of the data will be used to: 1) describe univariate and bivariate sample distributions of the data; 2) identify the interrelationships between variables; and 3) check for the violation of assumptions underlying identified statistical techniques, for example normality of model errors and presence of outlying values. The possible existence of univariate and multivariate outliers will be assessed in order to avoid distortion of descriptive or test statistics, type I or type II errors, and/or results that are not generalizable to the population of interest. Sensitivity analyses will be performed without outlying values to determine the outliers' influence on the results. If outliers are determined to overly influence results, these values will be excluded from the analysis and the outliers will be completely described or steps will be taken to minimize their influence, e.g., data transformations. If additional statistical assumptions are severely violated, data transformations or more statistically robust procedures (i.e., nonparametric methods) will be used. Also to be examined: (a) comparability of racial groups, (b) the need for covariate adjustment, (c) population representativeness of the sample as a result of dropouts, and (d) the internal consistency and validity of established scales. The internal consistency of scales will be estimated using Cronbach's coefficient alpha.

1.6.2 Primary Aim #1

Investigate if there are differences between black and white persons in the percentage of weight change at 18 months post-completion of the PREFER study as well as successful weight maintenance defined as ≤ 10% weight regain.

Analysis. Percentage of weight change at 18 months post-completion of the PREFER Trial will be calculated and expressed as a percentage of the weight change relative to weight at the completion of the PREFER study by the following equation:

$$\frac{\textit{weight at 18 months - PREFER study completion weight}}{\textit{PREFER study completion weight}} \times 100 = \% \Delta \text{ weight } (\textit{weight change})$$

Negative scores will indicate weight loss; positive scores will indicate weight gain. Additionally, a binary variable to indicate ≤ 10% regain over 18 months (yes=0, no=1) will be derived to indicate successful long-term weight maintenance. Appropriate descriptive statistics will be computed for the total sample and the black and white participants. The percentage change in weight will be summarized using means, standard deviations, medians, and ranges, while the indicator for weight regain will be summarized using frequency counts and percentages. Provided the data for the percentage weight change are normally distributed and because the groups are independent, two sample *t*-tests will be used to determine any significant differences in weight change between racial groups. If heterogeneity of group variances is suggested by the Levene test, an independent-sample *t*-test using separate estimates of the group variances will be used. If the data are not normally distributed, the non-parametric Mann-Whitney U test will be used. For the binary version of weight maintenance, contingency table analysis using chi-square tests of independence will be used to compare the proportions of successful/

unsuccessful participants between the racial groups. If sparse cells are present (observed count < 5), Fisher's exact chi-square statistic will be used. Lastly, if covariates are identified through data screening, multiple linear regression analysis (or logistic regression for the binary outcome) will be used to adjust for the effects of covariates. Regression models will be built hierarchically with covariates added in the first block, and a dummy coded variable for race (White = 0, Black = 1) will be added in the second block to determine the effect of race on weight maintenance after controlling for the effects of covariates. The statistics examined in the linear regression models will be the change in R^2 for the improvement in prediction from one model to the next, the estimate and standard error of the estimate. The improvement in the chi-square statistic will be examined when using the logistic regression. If sparse cells are present (observed count < 5) in the logistic regression, exact estimation algorithms will be used. Model fit will be assessed through the use of residual analysis and influential diagnostics. For the logistic regression, goodness-of-fit statistics, e.g. Hosmer-Lemeshow goodness-of-fit test, will be assessed to determine the fit of the model.

1.6.3 Primary Aim #2

To describe the behavioral strategies utilized by black and white persons for weight maintenance.

Analysis. Based on the Behavioral Strategy Survey, descriptive statistics (means, standard deviations, medians, ranges) will be used to report on percentage of the time over the previous 18 months that each behavioral strategy was used. The total sample will be stratified (by Blacks vs. Whites, successful vs. unsuccessful participants as well as successful vs. unsuccessful within each racial group) and descriptive statistics (means, standard deviations, medians, ranges) will be

presented for the percentage of time that each strategy was used by each group. For both the total sample and each group, interval estimates (95% confidence interval) will also be computed.

1.6.4 Primary Aim #3

To examine the influence of predictors (experiences in following a low-fat diet, barriers to healthy eating, self-efficacy) on percent weight change and successful weight maintenance as well as whether race moderates the relationship between predictors and weight maintenance.

Analysis. Percentage change scores (completion of PREFER to 18 months) will be calculated for the predictors measured by the questionnaires used in the PREFER study, and the score for the one-time measure, Self-Efficacy for Exercise, will be used as a concurrent predictor. Predictors will be examined individually first using simple linear regression in order to select discriminating variables and identify a parsimonious model. Assuming normality of the residuals, homoscedasticity of error variance, independence of observations, and linearity of variables, hierarchical multiple linear regression will then be used to identify factors that predict percentage weight change. This technique permits inspection of possible confounding variables while examining principal relationships of interest. (Munro, 2005). If identified through data screening, potential covariates such as income, education, and age will be added first in the first block; the predictor variables of interest, i.e., low-fat diet experiences, barriers to healthy eating, self-efficacy (diet and exercise), will be treated as continuous variables and added in the second block. Race will be dummy coded and added in the third block to determine its effect on weight maintenance after controlling for other variables. In the fourth block, interactions between racial group and each predictor will be considered to investigate possible effect modification (i.e., moderation) due to race. Higher order effects for predictor variables (i.e., cubic or quadratic

terms) will also be explored in order to improve fit and prediction. Additionally, weight maintenance will be examined using a binary outcome; participants will be dichotomized into "regainers: > 10% weight regain" and "maintainers: ≤ 10% regain." Any participants who have lost further weight will be considered maintainers as they will also have had a ≤ 10% regain. Using multiple binary logistic regression in a hierarchical fashion, as described above for linear regression, the impact of the predictors (and possible higher order effects) will be examined, controlling for possible covariates and considering possible interactions with racial group. The statistics examined in the linear regression models will be the change in R^2 for the improvement in prediction from one model to the next, the estimate, and standard error of the estimate. The improvement in the chi-square statistic will be examined in the logistic regression. If sparse cells are present (observed count < 5) in the logistic regression, exact estimation testing will be used. Model fit will be assessed through the use of residual analysis and influential diagnostics. For the logistic regression, goodness-of-fit statistics, e.g. Hosmer-Lemeshow, will be assessed to determine the fit of the model.

1.6.5 Secondary Aim #1

To explore the role of social support in weight maintenance for black and white persons.

Analysis. Social support will be measured in the 3 items from the Barriers to Healthy Eating Questionnaire and 4 items in the Experiences in Following a Low-fat Diet Questionnaire, as determined by factor analysis (Burke et al., 2004; Urban et al., 1992). A composite score will be calculated from the seven items and described using appropriate descriptive statistics for the total sample and each group. In order to avoid mullticollinearity with the Barriers and Experiences scores and assuming the need for covariate adjustment in the first block, multiple

linear and multiple binary logistic regression models, as discussed above for Primary Aim #3, will be estimated considering percent change in social support in the second block by itself as a separate predictor. Race will then be added to the third block to determine its effect on weight maintenance after controlling for other variables. In the fourth block, interactions between racial group and social support will be considered to investigate possible effect modification (i.e., moderation) due to race.

1.6.6 Secondary Aim #2

To describe the impact of stress on weight maintenance for black and white persons.

Analysis. Stress will be analyzed descriptively using four items from the Behavioral Strategy Survey. Frequencies will be calculated regarding the percentage of time participants reported that stress influenced their eating and the percentage of time that stress-reducing techniques were used. Descriptive frequencies will also be used to analyze the stressful life events reported and the effect scores of the stressful life event(s) on eating habits. A mean score for each of the three continuous items will be computed. Multiple linear and multiple binary logistic regression models, as discussed above for Primary Aim #3 and Secondary Aim #1, will then be estimated considering stress as a separate possible concurrent predictor. Interactions between racial group and stress will be considered to investigate possible effect modification due to race.

1.6.7 Secondary Aim #3

Explore the roles of dietary intake and physical activity as potential mediators of weight maintenance.

Analysis. Path analysis will be used to determine the roles of dietary intake and physical activity as possible mediators of the relationship between weight maintenance and the potential predictor variables (self-efficacy, low-fat diet experiences, barriers to healthy eating, social support, stress). Because the sample size is fairly small for path analysis and the recommendation of 30 participants per independent variable cannot be met (Munro, 2005), only an exploration of these concepts will be undertaken. In order to examine mediation, models analyzing both the direct effect of each of the predictors on weight maintenance and their indirect effects through dietary intake (fat gram and calorie intake) and physical activity will be fitted. According to Baron and Kenny (1986), three regression equations will be estimated for each predictor: 1) regressing the dependent variable on the predictor, 2) regressing the mediator on the predictor, and 3) regressing the dependent variable on both the predictor and the mediator concurrently (Baron & Kenny, 1986). Paths with large standardized values between the predictor and mediator (dietary intake or physical activity) and between the mediator and weight maintenance will indicate full mediating effect where the direct effect between the predictor and weight maintenance is getting smaller in magnitude. The Sobel test will be used to determine if the effect of the predictor on weight maintenance is significantly reduced when the mediator is included in the model (Sobel, 1982). The estimation of effect sizes using standardized path coefficients will be emphasized rather than the strict testing of hypothesized relationships. Given the small to moderate sample size, bootstrapping will also be considered.

1.6.8 Effect Size Estimation and Power

Effect sizes are rarely reported in the weight management literature; however, medium effect sizes for behavioral weight-loss treatment, e.g., .30 and .50, have been reported for weight change in weight-loss and weight-maintenance studies (Leibbrand & Fichter, 2002; Wing, Jeffery, Hellerstedt, & Burton, 1996). Because sample size is fixed, and a total of 119 participants have been recruited for the dissertation study (81 non-minorities and 36 minorities), estimates of effect sizes will be presented based upon pilot analyses from the maintenance period of PREFER, 12 to 18 months. The mean percent weight change (*SD*) for the minority group was +3.7 (3.9)%; the mean percent weight change (*SD*) for the non-minority group was +3.3 (4.1)% in the pilot analysis. For the continuous outcome variable in primary aim #1, in order to achieve 80% power with group sample sizes of 83 white participants and 27 black participants given the existing group standard deviations, a 2.2% difference in mean percent weight change between racial groups would be needed to reject the null hypothesis of no difference in percent weight change between groups, with a significance level of .05 using a two-sided two-sample *t*-test. This difference would result in an effect size of $d = .549$, a medium-size effect; the effect size present in the pilot analysis based on a mean difference of .4% is $d = .10$, a small effect size (Cohen, 1988).

In primary aim #1 for the categorical variable successful/unsuccessful weight maintenance (defined as ≤ 10% regain and > 10% regain, respectively) the pilot analysis revealed the proportions of minorities and non-minorities regaining ≤ 10% to be the same. Therefore, proportions were projected based upon the prevalence of obesity for non-Hispanic Blacks and non-Hispanic Whites in 2003-2004, 45% and 31%, respectively (Ogden et al., 2006). Group sample sizes of 83 for the non-minorities and 36 for the minorities achieve 80% power to

detect a difference between the group proportions of .256. The proportion in the minority group is assumed to be .45 under the null hypothesis and .194 under the alternative hypothesis. The test statistic used is the two-sided Likelihood Ratio test at a significance level of .05. The estimated effect size for the 2x2 Chi-square test statistic of 1.892 with a sample size of 119 is $\Phi =$ .126, a small effect (Rosenthal, 1984).

Primary aim #2 utilizes descriptive statistics only; therefore, no estimations of power or effect size were performed for this aim. For the total sample and each racial group, interval estimates (95% confidence interval) will be computed.

For primary aim #3, using hierarchical multiple regression to examine the influence of predictors on percent weight change, the first model considered only the behavioral variables (barriers to healthy eating, low-fat diet experiences, self-efficacy) as predictors of percent weight change. Based on the pilot analysis from the PREFER data where no potential sociodemographic covariates were identified, an R^2 of .05 was found for the three behavioral predictors. A sample size of 119 achieves 80% power to detect an R^2 of .087 attributed to 3 independent variables using an *F*-test with a significance level of .05, which equates to an effect size of $f^2 = .095$, a small effect size for social science research (Cohen, 1988). A sample size of 119 achieves 80% power to detect an incremental R^2 of .06 attributed to racial group after adjusting for the 3 behavioral variables with an R^2 of .05. The R^2 change from model 1 with only the 3 behavioral predictors to model 2 with racial group added in the second block was .003, representing a very small effect size for racial group.

Also for primary aim #3, to examine the binary outcome of ≤ 10% regain or > 10% regain, a logistic regression of weight regain on the binary race variable with a sample size of 119 (of which 70% are non-minorities and 30% are minorities) achieves 80% power at .05

significance level to detect a change in probability from the baseline value of .69 to .41. This change represents an odds ratio (effect size) of .31. An adjustment was made since a logistic regression of the race variable on the other behavioral variables in the logistic regression resulted in an R^2 of .044 (Cox and Snell). This odds ratio suggests that the likelihood of successful weight maintenance for minorities is 0.3 times the likelihood of successful weight maintenance for non-minorities. In other words, minorities are 1.3 times more likely to be unsuccessful at weight maintenance compared to non-minorities according to projections from the statistics regarding obesity for Blacks and Whites in 2003-2004.

Stress and social support will be tested in separate models for secondary aims 1 and 2. A sample size of 119 achieves 80% power to detect an R^2 of .06 attributed to one predictor using an F-test with a significance level of .05. When race is added to the second blocks of the separate models after controlling for the effect of stress or social support in the first block, a sample size of 119 achieves 80% power to detect an R^2 of .06. This is a small effect size of $f^2 = .064$ (Cohen, 1988).

In examining effect sizes for secondary aim 3 which explores the mediating effects of dietary intake (fat grams and calories) and physical activity on predictors of weight maintenance (self-efficacy, barriers to healthy eating, low-fat diet experiences, social support), pilot analyses of the PREFER data revealed that the association of self-efficacy with weight change was influenced by fat gram intake, calorie intake, and physical activity. Estimated effect sizes for these mediator variables, reflected in the change in R^2, was .014, .001, and .002 for fat gram intake, calorie intake, and physical activity, respectively; each potential mediator was added to the second block in separate regression models with self-efficacy in the first block predicting weight change, in order to determine an estimated effect size for each mediator. The relationship

with other predictor variables (barriers to healthy eating, low-fat diet experiences, social support) and weight change was not influenced by the potential mediators (fat gram intake, calorie intake, and physical activity) in the pilot study, but will still be explored in the dissertation analysis.

1.7 STUDY LIMITATIONS

A limitation of this study is the self-report nature of the data collected, in particular, dietary intake and physical activity. No measure of food intake is ideal (Kipnis et al., 2002; Lissner, 2002), and under-reporting dietary intake is not uncommon (Hill & Davies, 2001; Martin, Su, Jones, Lockwood, Tritchler, & Boyd, 1996), particularly in persons who are overweight or obese (Johansson, Wikman, Ahren, Hallmans, & Johnansson, 2001; Muhlheim, Allison, Heshka, & Heymsfield, 1998). Additionally, over-reporting of physical activity in persons with a higher BMI has been documented (Buchowski, Townsend, Chen, Acra, & Sun, 1999; Irwin, Ainsworth, & Conway, 2001; Jakicic, Polley, & Wing, 1998; Walsh, Hunter, Sirikul, & Gower, 2004; Washburn, Jacobsen, Sonko, Hill, & Donnelly, 2003), and has been associated with poorer weight-loss outcomes (Jakicic et al., 1998). These limitations are difficult to overcome as a result of the design and financial constraints of the dissertation study. Because of the ancillary nature of the study, the measurement tools were based upon the measures used in the PREFER study, with the exception of the 24-hour dietary recalls.

The PREFER trial used the 3-Day Food Diary, which included nonconsecutive days (one non-working day and two work days) that are representative of their typical eating habits. The PI of the PREFER study conducted an ancillary study of her own at the same time as data collection for the first cohort of the dissertation study and decided to switch to 24-hour dietary recalls for

assessment of food intake as the recalls are considered more accurate. Therefore, 24-hour dietary recalls were continued for the second and third cohorts of the dissertation study to maintain data consistency. Both of these measures will be analyzed for total caloric and fat gram intake using the NDSR software, but there might be some difference in self-reported food intake because the 3-Day Food Diary is a planned recording of foods eaten and could influence actual eating; the 24-hour dietary recall assessment is unannounced and collects past behavior data. The measurement of dietary intake is unfortunately limited to self-report, as no objective measures of consumed foods are currently available. A possible method to increase the accuracy of the data would be to collect several measures of dietary intake and compare the similarity of the data. This technique would unfortunately only present a measure of reliability in terms of what the participant reported and would increase subject burden without increasing the validity of the assessment. The "gold standard" for measuring energy expenditure and physical activity in free-living individuals is the use of doubly labeled water (Ravussin, Harper, Rising, & Bogardus, 1991; Schoeller & van Santen, 1982; Schoeller & Webb, 1984). This technique is based on the difference in the elimination of deuterium (^{2}H) and ^{18}oxygen (^{18}O, eliminated as water and carbon dioxide) from body water after an oral dose of the two stable isotopes; energy expenditure is calculated from the production of carbon dioxide using equations for indirect calorimetry (Mann et al., 2007; Tataranni & Ravussin, 2002). However, it is very expensive, costs more than $1000 to assess a 70 kg person (Speakman, 1997), and was not used in the PREFER study.

A possible limitation of the dissertation study is a potential differential recruitment of participants who have done well in terms of maintaining their weight since the completion of the PREFER study. This selection bias is a pitfall of long-term weight-loss studies (Cox et al., 2007;

Heshka et al., 2003; Phelan, Hill, Lang, Dibelllo, & Wing, 2003), but every attempt will be made to encourage all eligible participants to return for the dissertation study no matter what they currently weigh. The recruitment letter stresses that information is needed from participants who were not as successful in their maintenance efforts as well from those who were.

1.8 PROTECTION OF RESEARCH PARTICIPANTS

The researcher will seek approval for the research through the University of Pittsburgh IRB. The IRB will approve all aspects of the study before any research activities are initiated. Potential risks to the research participants are minimal and include possible embarrassment if they have regained weight; this risk will be minimized as much as possible by voicing acceptance of the participant and emphasizing that this study is to learn how to help individuals with maintenance of lost weight. All weights will be obtained in a private setting. The potential risk of breach of confidentiality is reduced by keeping identifying personal information in a separate, locked filing cabinet from the research data. Data will be de-identified, assigned an identification number, and kept in another locked filing cabinet.

The population of the dissertation study is based on the demographic characteristics of the PREFER study. Characteristics of the sample include male and female (87.4%) adults age 18-55 years old at enrollment of the PREFER study and a 29.5% representation of minorities, which is characteristic of the Pittsburgh regional area. Because the primary interest is in exploring racial differences in weight maintenance, recruitment activities will make every effort to maintain this proportion. Dr. Stephen Thomas, Director of the Center for Minority Health, is a consultant to the dissertation study and will provide assistance in recruiting PREFER study

minority persons to participate. Children under 18 years of age were not included in the PREFER study due to the need for parental involvement. Adults beyond 55 years old were not included in the PREFER study to reduce the possibility of co-morbid conditions that might prohibit participation in physical activity.

1.9 PUBLICATIONS

*Refereed Articles (*databased)*

*Burke, L.E., **Warziski, M**., Starrett, T., Choo, J., Music, E., Sereika, S., Stark, S. & Sevick, M.A. (2005). Self-monitoring dietary intake: Current and future practices. *Journal of Renal Nutrition*, *15*(3), 281-290.

*Burke, L.E., Choo, J., Music, E., **Warziski, M.**, Styn, M.A., Kim, Y., & Sevick, M.A. (2006). PREFER study: A randomized clinical trial testing treatment preference and two dietary options in behavioral weight management– Rationale, design and baseline characteristics. *Contemporary Clinical Trials*, *27*, 34-48.

*Burke, L.E., Sereika, S., Choo, J., **Warziski, M.**, Music, E., Styn, M.A., Novak, J., & Stone, A. (2006). Ancillary study to the PREFER trial: A descriptive study of participants' patterns of self-monitoring – Rationale, design and preliminary results. *Contemporary Clinical Trials*, *27*, 23-33.

*Burke, L.E., Styn, M.A., Music, E., **Warziski, M.**, Aaron, D., Choo, J. & Sereika, S. (2006). A randomized clinical trial testing treatment preference and two dietary options in behavioral weight management: Preliminary results of the impact of diet at 6 months--PREFER study. *Obesity*, *14*(11), 2007-2017.

*__Warziski, M.__, Sereika, S.M., Styn, M.A., Music, E., Burke, L.E. (2007). Changes in self-efficacy and dietary adherence: The impact on weight loss in the PREFER study. *Journal of Behavioral Medicine*, *31,* 81-92.

*Burke, L.E., __Warziski, M.__, Styn, M.A., Music, E., Hudson, A.G., & Sereika, S.M. (2008). A randomized clinical trial of a standard versus vegetarian diet for weight loss: The impact of treatment preference. *International Journal of Obesity*, *32*, 166-176.

*Burke, L.E., Hudson, A.G., __Warziski, M.__, Styn, M.A., Music, E., Elci, O.U., Sereika, S.M. (2007). Effects of a vegetarian diet and treatment preference on biological and dietary variables in overweight and obese adults: A randomized clinical trial. *American Journal of Clinical Nutrition*, *86*, 588-596.

* Burke, L.E., Sereika, S.M., Music, E., __Warziski, M.__, Styn, M.A., Stone, A. (2008). Using instrumented paper diaries to document self-monitoring patterns in weight loss. *Contemporary Clinical Trials*, *29*, 182-193.

Book Chapters

__Warziski, M.__, Choo, J., Novak, J., & Burke, L.E. (2008). Obesity. In D. Moser & B. Riegel (Eds.), *Cardiac nursing: A companion to Braunwald's heart disease* (pp. 446-484). St. Louis: Saunders.

Published Abstracts

Burke, L.E, Sereika, S., Choo, J., __Warziski, M.__, Novak, J., Music, E. & Cartwright, M. (2005). Self-monitoring among subjects in a weight loss study. *European Journal of Cardiovascular Nursing*, *4*(1), 64-65.

Burke, L.E., Choo, J., Music, E., Cartwright, M., __Warziski, M.__, & Kim, Y. (2005). Does

receiving treatment preference affect adherence and weight loss? *Annals of Behavioral Medicine*, *29*(Suppl.) S080.

Choo, J., Aaron, D.J., Sereika, S.M., Music, E., **Warziski, M**., Novak, J., Burke, L.E. (2005). Physical activity alone does not positively affect the metabolic syndrome in overweight and obese subjects. *Circulation*, *112*(Suppl. II), II-830.

Music, E., Choo, J., Styn, M., **Warziski, M.**, & Burke, L.E. (2006). Feasibility study: Using PDA-based Dietmate Pro® for dietary self-monitoring. *Annals of Behavioral Medicine*, *31* (Suppl.), S058.

Choo, J., Steenkiste, A., Styn, M., Music, E., **Warziski, M.**, & Burke, L.E. (2006). The impact of weight loss on quality of life in a behavioral intervention. *Annals of Behavioral Medicine*, *31*(Suppl.), S124.

Burke, L.E., Styn, M., Steenkiste, A., Music, E., **Warziski, M.**, & Choo, J. (2006). The impact of adding a vegetarian diet to standard behavioral treatment for weight loss: Preliminary results. *Annals of Behavioral Medicine*, *31*(Suppl.), S017.

Burke, L.E., Choo, J., Music, E., **Warziski, M.**, Styn, M., Novak, J., & Sereika, S. (2006). Patterns of self-monitoring behavior affect weight change among weight loss study participants. *Annals of Behavioral Medicine*, *31*(Suppl.), S017.

Burke, L.E., **Warziski, M.**, Acharya, S., Styn, M., Steenkiste, A., Music, E., Ewing, L., Aaron, D., & Sereika, S. (2006). PREFER Trial: A randomized clinical trial testing treatment preference and two dietary options combined with behavioral weight management. *Obesity Research*, *14*(Suppl.), A32.

Burke, L.E., Music, E., Styn, M., **Warziski, M.**, & Sereika, S. (2006). Self-monitoring declines

over time in a study of behavioral treatment for weight loss. *Obesity Research*, *14*(Suppl.), A175.

Burke, L.E., Acharya, S., **Warziski, M.**, Styn, M., Steenkiste, A., Ewing, L., & Aaron, D. (2006). Does adherence to a lacto-ovo-vegetarian diet affect weight loss? *Circulation*, *114*(8) (Suppl.), II-518.

Burke, L.E. Music, E., Styn, M., & **Warziski, M.** (2006). Using technology to improve self-monitoring in weight loss. *International Journal of Behavioral Medicine*, *13*(Suppl.), 192.

Warziski, M., Sereika, S.M., Styn, M.A., Elci, O.U., Burke, L.E. (2007). Does weight loss maintenance differ for minorities compared to non-minorities? *Circulation*, *115*(Suppl. 8), e243.

Acharya, S., Elci, O.U., Music, E., **Warziski, M.**, Styn, M.A., Burke, L.E. (2007). Patterns of adherence to standard behavioral weight loss treatment. *Circulation*, *115*(Suppl. 8), e245.

Burke, L.E., Styn, M.A., Elci, O.U., Music, E., **Warziski, M.** (2007). How do barriers to healthy eating impact weight loss? *Circulation*, *115*(Suppl. 8), e246.

Warziski, M., Sereika, S.M., Styn, M.A., Music, E., Burke, L.E. (2007). Is weight loss self-efficacy different for study participants randomized to a vegetarian diet? *Annals of Behavioral Medicine*, *33*(Suppl.), S192.

Styn, M.A., Music, E., **Warziski, M.**, Burke, L.E. (2007). Dietary practices among people seeking weight loss treatment. *Annals of Behavioral Medicine*, *33*(Suppl.), S197.

Ewing, L. Hudson, A.G., **Warziski, M.**, Styn, M.A., Elci, O.U., Sereika, S.M., Burke, L.E. (2007). Differences in baseline binge eating scale scores predict participants' completion and return for follow-up in a weight loss trial. *Annals of Behavioral Medicine*, *33*(Suppl.)

S194.

Acharya, S., Elci, O.U., Styn, M.A., **Warziski, M.**, Music, E., Sereika, S.M., Burke, L.E. (2007). Adherence to a multi-component treatment protocol in a behavioral weight loss study. *Annals of Behavioral Medicine*, *33*(Suppl.), S089.

Burke, L.E., Styn, M.A., Elci, O.U., Sereika, S.M., Music, E., **Warziski, M.** (2007). Experiences following a low fat diet influence dietary maintenance. *Annals of Behavioral Medicine*, *33*(Suppl.), S186.

1.10 RESEARCH PARTICIPANT RISK AND PROTECTION

Human Participants

Description. The population of the dissertation study is based on the demographic characteristics of the PREFER study. Characteristics of the sample population: male and female adults and 18-55 years old at enrollment of the PREFER study, including 87.4% females; this proportion will likely be maintained. The PREFER study had a representation of 29.5% minorities, and recruitment activities will make every effort to maintain this proportion. Dr. Stephen Thomas, Director of the Center for Minority Health, is a consultant to the dissertation study and will provide assistance in the recruitment of PREFER study minority participants. The eligibility criteria are dictated by the inclusion criteria of the PREFER study; participants were 18-55 years old at enrollment of the PREFER study, agreeable to randomization to their treatment preference or not and one of the two dietary plans, had a BMI between 27 and 43 kg/m^2, inclusively, and had adequately completed a 5-day food intake diary. Females of childbearing potential will be included in this study since there is no intervention is being used. All 132 participants from the

PREFER study who complete the final assessment are eligible for the dissertation study, and no one will be excluded based on current weight, age, gender, or ethnicity.

According to the inclusion criteria of the PREFER, children under the age of 18 and adults older than 55 were not eligible to participate, and thus will not be included in the dissertation study. Children under 18 years of age were not included in the PREFER study because of the need for comprehension of the two dietary choices and identification of a preferred choice. Furthermore, the adoption of a reduced-calorie and reduced-fat eating plan or a vegetarian eating plan necessitates significant changes in meal selection and preparation, which could not be accomplished without parental supervision. The PREFER study intervention protocol did not allow for parental involvement. Those older than 55 were excluded from the PREFER study to reduce the chance of co-occurring medical conditions that might not allow for participation in physical activity.

Sources of data. Existing data from the completion of the PREFER study— weight, 3-Day Food Diary, Paffenbarger Activity Questionnaire, Experiences Associated with Following a Low-fat Diet Scale, Barriers to Healthy Eating Scale, and Weight Efficacy Lifestyle Questionnaire— will be used in the dissertation study. These data, which have previously been de-identified, exist in the secure database of the PREFER study. Data not collected as part of the PREFER trial but used in the dissertation study include the Self-Efficacy for Exercise Scale, Behavioral Strategy Survey, and 24-hour dietary recalls. All new data and documents will be de-identified and maintained so that no linkage can be made to the individual enrolled in the study. All data with only identification numbers will be stored in a locked filing cabinet, and all records connecting names to ID numbers will be stored in a separate locked filing cabinet. Dietary recall data are de-identified and stored in a secure database. All data will be compliant with the

guidelines of the Complete Health Insurance Portability and Accountability Act (HIPPA) of 1996, and no data will be able to be linked to the individual participant.

Recruitment procedures. Eligible participants will receive a letter from the PI of the PREFER study and the PI of the dissertation study, and a consent form approximately 16 months post-completion of the PREFER study. The letter will explain the interest in exploring the factors involved in weight maintenance and ask that they return for one assessment. To encourage participants who may be reluctant to respond because they have gained weight, the letter will stress the interest in examining issues related to weight management regardless of current weight. See Appendix E for letter. During the phone call, the study will be explained to the participant, and the person will be asked if he/she has any questions about the consent form. Consent forms will be returned by mail and participants will be mailed the questionnaires and contacted to schedule an appointment for their weight assessment once the consent form is received; a copy of the consent form will be given to the participant at their appointment. Written informed consent will be obtained per IRB protocol to allow the use of secondary data from the PREFER study as well as to collect the additional measures described above. The PREFER study had a 76% ($N = 132$) retention of participants at the final assessment. Due to the high retention of the PREFER study, the projected loss of participants for the dissertation study is an additional 10% beyond that of the PREFER study. Based on PREFER study retention and subsequent attrition at 18-month follow-up, a projected recruitment of 119 participants is expected, maintaining the 29.5% minority composition (84 non-minorities, 35 minorities).

Potential risks. There are minimal risks involved in participation in the proposed ancillary study. No intervention with any inherent risks is being conducted and no other potential physical, psychological, social, or legal risks are anticipated. Participants may feel embarrassed

if they have regained weight. The likelihood of this occurrence in unknown, but will be minimized by the fact that the PI is known to the participants and assisted with the weigh-ins during the intervention. Any participant discomfort issues will be directed to Dr. Lora Burke and Dr. Lin Ewing. Dr. Ewing is a clinical psychologist and will provide direct guidance in dealing with any participant distress related to weight regain. The potential risk for loss of confidentiality also exists; however, the likelihood of this occurring is minimal because the PI will be the only one accessing the data, and all data will be de-identified and secured as described under Sources of Data.

Procedures to minimize risks. The risk of embarrassment will be minimized as much as possible by verbalizing acceptance of the participant at his/her current weight and emphasizing that we are trying to learn how to help individuals maintain their weight loss. All weights will be obtained in a private area. Persons with a serious illness or under treatment for a psychological disorder will have been previously excluded from the PREFER study and therefore not eligible for the dissertation study. If a participant has developed an illness requiring psychiatric treatment in the 18-month interim, this person will be excluded for the protection of the participant. The risk for loss of confidentiality will be minimized by de-identifying data and using the procedures discussed under Sources of Data. The PI will meet bi-weekly with the PI of PREFER to review accrual of participants and data quality to make certain that there are no changes in the risk/benefit ratio. The risk for the dissertation study is significantly less than the PREFER study since there are no interventions and no invasive procedures e.g. blood draws. The most significant risk is the potential for participant discomfort due to weight regain. Any questions or concerns related to participant safety or comfort will be directed to Dr. Lora Burke and Dr. Lin Ewing. Because Dr. Ewing is a clinical psychologist, she will provide direct guidance in

handling any participant distress. The PI will immediately report any adverse events to the University of Pittsburgh IRB and will notify the NIH and IRB of any necessary modifications to this protocol. No protocol modification will be instituted without IRB approval.

Cost-to-benefit ratio. While no direct benefit to the participant may result from taking part in the dissertation study, there is a hope that future participants will benefit from the information acquired, which will assist in the generation and implementation of behavioral interventions to improve long-term weight maintenance with strategies tailored to possible racial differences.

Research Study Costs: All research costs will be covered by the dissertation study.

Research Study Payments: Participants will be compensated for their time with a $25.00 gift certificate to Giant Eagle grocery stores.

Vertebrae animals: None.

2.0 SUMMARY OF DISSERTATION STUDY

The dissertation project examined weight maintenance after a behavioral weight loss trial, PREFER, and explored whether differences existed between black and white participants in percent weight change and successful weight maintenance 18 months after the trial. In the original proposal, successful weight maintenance was defined as ≤ 10% weight regain. However, after examining the data, this cut point would have resulted in a very small cell size (< 5) for the black participants in the unsuccessful group, making the use of the planned logistic regression analysis problematic as the model could become unstable and result in inappropriate maximum likelihood estimates (Stokes, Davis, & Koch, 2001). Although a procedure is available in the SAS statistical software package (SAS Institute Inc., Cary, NC, USA) to handle logistic regression with small cell counts, i.e. PROC LOGISTIC EXACT, the existing literature on weight maintenance often uses either a 5% or 10% weight change cut point to define successful weight maintenance after loss (Field, Wing, Manson, Spiegelman, & Willett, 2001; Gosselin & Cote, 2001; Lowe, Miller-Kovach, & Phelan, 2001; Stevens, Truesdale, McClain, & Cai, 2006), and in fact, more recent publications use the 5% weight gain marker (Befort, Stewart, Smith, Gibson, Sullivan et al., 2007; Cox, Malpede, Desmond, Faulk, Myer et al., 2007; Greene, Malpede, Henson, Hubbert, Heimburger et al., 2006). Therefore, after consultation with Drs. Burke and Sereika, the decision was made to redefine successful weight maintenance as ≤ 5%

regain. The findings from the dissertation study are organized and presented in three manuscripts as described below.

The first manuscript, An Exploration of Racial Differences and Psychosocial Correlates of Weight Maintenance after a Behavioral Weight Loss Trial, addresses the following specific aims:

Primary aim 1. Investigate if there are differences between black and white persons in the percentage of weight change, as well as successful weight maintenance defined as ≤ 5% weight regain, at 18 months post-completion of the PREFER study.

Primary aim 3. Examine the influence of possible predictors (self-efficacy, experiences in following a low-fat diet, barriers to healthy eating) on percentage of weight change and successful weight maintenance and whether race moderates the relationship between identified predictors and weight maintenance.

Secondary aim 1. Describe the impact of social support on weight maintenance for black and white persons.

Secondary aim 2. Describe the impact of stress on weight maintenance for black and white persons.

In brief, there was no significant difference in percent weight change (p = .55) or unsuccessful weight maintenance (p = .53) between the black and white participants with both groups gaining approximately 5% of their weight. Race did not moderate the relationship between the predictors and weight change or unsuccessful weight maintenance, ps > .10. An increase in barriers to healthy eating and the effect of a stressful life event on eating were significantly associated with weight regain and unsuccessful weight maintenance, ps < .04. Although a difference in weight change between black and white participants after the weight

loss trial was not supported, these findings indicate the need to develop novel strategies to assist all individuals overcome barriers to following a healthful dietary plan and deal with stressful life events.

The findings for the second primary aim are described in the second manuscript, Use of Behavioral Strategies for Weight Maintenance 18 Months after a Behavioral Weight Loss.

Primary aim 2. Describe the behavioral strategies utilized by black and white persons for weight maintenance.

This analysis examined the percentage of the time participants used behavioral weight management strategies they learned during the weight loss trial. Whether or not a difference existed in strategy use between black and white participants as well as between successful and unsuccessful weight maintainers was also explored. Only a quarter of the behavioral strategies were used for more than half the time. For all participants, reading food labels while grocery shopping was the strategy used for the greatest proportion of the time. Two differences in strategy use were found between the black and white participants; black participants used recipe modification and portion-control methods for significantly less time than white participants, *p*s < .04. Successful and unsuccessful participants did not differ in strategy use. Because individuals who are successful at weight maintenance report using a number of behavioral strategies to manage their weight, (Befort et al., 2007; Kitsantas, 2000; Leser, Yanovski, & Yanovski, 2002; McGuire, Wing, Klem, Seagle, & Hill, 1998; Wing & Hill, 2001), methods to promote the continuation of behavioral strategies long-term are needed. A few differences existed in strategy use between racial groups supporting the incorporation of culturally-tailored intervention techniques in weight management programs to meet the needs of these individuals.

The third manuscript, Dietary Intake and Physical Activity as Potential Mediators of the Relationship between Psychosocial Variables and Weight Maintenance after a Weight Loss Trial, addresses the third secondary aim:

Secondary aim 3. Explore the roles of dietary intake and physical activity as potential mediators of the relationships between weight maintenance and 1) barriers to healthy eating, 2) experiences in following a low-fat diet, 3) self-efficacy, 4) social support, and 5) stress.

Calorie and fat gram intake and physical activity did not mediate the relationship between the psychosocial variables and weight maintenance. Increases in the BHE scale, decreases in the ELF scale, and decreases in the WEL scale as well as a greater effect of a stressful life event on eating were found to significantly predict weight regain in univariate analyses, ps $< .03$. An increase in barriers also predicted increased fat gram intake, $p = .048$. Several focus areas for weight maintenance interventions are identified through these findings, e.g., helping individuals learn to decrease barriers to healthy eating, increase positive experiences while following a low-fat dietary lifestyle, augment eating-related self-efficacy, and appropriately deal with stressful life events.

This research project has several strengths and some limitations. These are addressed in greater detail in the manuscripts but are highlighted here. The strengths of this investigation include that it was a long-term assessment of weight maintenance and adds to the limited findings regarding long-term weight maintenance after a behavioral weight loss trial. This project explored maintenance among black individuals, and there is little information about weight maintenance in this racial group. The study used an objective assessment of weight and a large proportion of participants who completed the weight loss trial returned to participate, reducing the possibility of biased findings resulting from only individuals who maintained their

weight participating in the follow-up study. The sample was originally recruited using multiple sources, e.g. mass mailings, posted advertisements, automated telephone announcement system, and participants were from a diverse community, supporting the generalizability of the results. Limitations include a restriction of the sample selection to those who took part in the weight loss trial, thereby limiting the demographic characteristics of the participants and the representation of black participants. The sample size of 26 black individuals (22% of the sample) might not be deemed large enough to make conclusions about weight maintenance in this racial group. The small percentage of men would suggest that the results could be generalized only to women. The socioeconomic status of the sample was somewhat higher than average for Allegheny County and Pennsylvania with more than half of the white and black participants reporting an annual household income of at least $50,000, and the mean level of education for the entire group was also relatively high at over 15 years of formal education. These factors might limit the generalizability of the findings to individuals at this socioeconomic level. Self-reported measurement of variables also introduces possible recall bias and social desirability when completing questionnaires. In particular, the dietary and physical activity assessments are subject to underreporting and over reporting, respectively. Manuscript three addresses this limitation further.

Implications for future studies are also discussed in the manuscripts. These include research that focuses on the most appropriate strategies for reducing participants' barriers to following a healthy eating plan and assisting individuals to cope with stressful life events in order to promote weight loss maintenance. Further investigations are needed to determine how to best encourage people to continue to use behavioral strategies for controlling weight. An exploration is warranted regarding how individuals choose or do not choose to utilize particular

behavior strategies for weight management. Future research needs to explore racial differences in the ability and interest of black persons in modifying recipes and using portion control methods. Additional studies should examine incorporating specific instructions on how to prepare more healthful ethnic dishes and ethnic-style meals (Gans, Kumanyika, Lovell, Risica, Goldman et al., 2003; Kumanyika, Shults, Fassbender, Whitt, Brake et al., 2005).

3.0 LITERATURE REVIEW MANUSCRIPT

Randomized Clinical Trials of Weight-loss Maintenance: A Review

3.1 ABSTRACT

The problem of overweight and obesity has reached epidemic proportions in the U.S. and globally, and the high prevalence is due in part to the recidivism associated with weight-loss treatment. Approximately one third of lost weight is often regained in the first year after treatment and, at times, continues. Because a plethora of co-morbid diseases are associated with obesity, in particular, cardiovascular disease, hypertension and hyperlipidemia, clinicians and researchers have attempted to find useful strategies for maintaining weight loss. This review presents the findings from 42 randomized clinical trials of weight-loss maintenance from 1984 through 2007 utilizing interventions that include 1) the Internet, 2) strategies after a very-low-calorie diet, 3) pharmacotherapy, 4) behavioral strategies, 5) physical activity, and 6) alternative strategies. The results of the reviewed trials revealed that treatment with orlistat or sibutramine combined with dietary modification, caffeine or protein supplementation, consuming a diet lower in fat, adherence to physical activity routines, prolonged contact with participants, problem-solving therapy, and the alternative treatment acupressure were efficacious in reducing weight regain after weight-loss treatment. The limitations of some studies may reduce the robustness of

their findings, and future studies are necessary to replicate and support these results so that individuals are able to maintain weight loss and retain the health benefits associated with a lower weight.

3.2 INTRODUCTION

Overweight and obesity are worldwide, chronic health problems that are associated with heart disease and stroke (Eckel, York, Rossner, Hubbard, Caterson et al., 2004), and 66.3% of the U.S. population falls into one of these two weight categories (Centers for Disease Control and Prevention, 2007). Overweight and obesity are measured by body mass index (BMI), i.e., weight in kilograms divided by height in meters squared. Overweight is defined as a BMI between 25.0 kg/m^2 and 29.9 kg/m^2 and obesity as a BMI $\geq$ 30 kg/m^2. Obesity is categorized further by obesity I (BMI between 30.0 kg/m^2 and 34.9 kg/m^2), obesity II (35.0 kg/m^2 to 39.9 kg/m^2), and a BMI greater than 40.0 kg/m^2 is obesity III or extreme obesity (National Heart Lung and Blood Institute Obesity Education Initiative Expert Panel on the Identification Evaluation and Treatment of Overweight and Obesity, 1998). With increasing levels of BMI, the associated level of risk for cardiovascular disease (CVD) and development of type 2 diabetes increases; a BMI $\geq$ 30 kg/m^2 is an independent risk factor for CVD (Klein, Burke, Bray, Blair, Allison et al., 2004). Moreover, central adiposity, mainly visceral fat, is a strong risk factor for hypertension, dyslipidemia, and insulin resistance (Adams & Murphy, 2000).

The usual course of weight-loss therapy shows that weight is lost quickly at first, and the point of greatest loss occurs 6 months after beginning treatment; then weight is slowly regained until weight returns near the original level (Jeffery, Drewnowski, Epstein, Stunkard, Wilson et

al., 2000). Often, 30-35% of the weight a person loses is regained during the first year after treatment (Wadden, Butryn, & Byrne, 2004), and weight gain frequently persists with an average loss of about 1.8 kg remaining at four years after treatment (Perri & Foreyt, 2004). Approximately 20% of individuals could be considered successful when *successful* weight-loss maintenance is defined as intentionally losing at least 10% of one's weight and maintaining that loss for a minimum of one year (Wing & Hill, 2001). While weight-loss treatment programs have succeeded at assisting people to lose weight, helping to maintain the loss has remained an elusive endeavor despite the use of multiple behavioral change strategies.

Investigations into how to best promote weight-loss maintenance have examined several strategies e.g., ongoing therapist contact, training in relapse prevention, problem-solving therapy, providing pre-packaged foods, incorporating support from peers, and including multifaceted programs after weight-loss treatment (Perri & Corsica, 2002). Relapse prevention training involves instruction in recognizing high-risk circumstances for potential lapses, practicing dealing with high-risk circumstances like eating at parties or restaurants, and restructuring negative thoughts to cope with guilt related to a lapse or failure (Marlatt & Gordon, 1980). The application of problem solving involves a 5-step process that includes having the individual identify the problem, formulate alternative solutions, make decisions, and test and evaluate those decisions until the problem is resolved (D'Zurilla & Goldfried, 1971). Yet even with interventions targeting relapse, the issue of poor maintenance of lost weight remains, causing some to question whether maintenance programs are helpful or only postpone weight regain at an added cost (Mustajoki & Pekkarinen, 1999).

Weight loss and maintenance can improve or even prevent risk factors for CVD and the development of co-morbidities related to obesity (Klein et al., 2004). Modest weight loss (5-10%

of initial weight) is associated with an improvement in several established risk factors for CVD e.g., hypertension (Masuo, Mikami, Ogihara, & Tuck, 2001; Mertens & Van Gaal, 2000; Neter, Stam, Kok, Grobbee, & Geleijnse, 2003), dyslipidemia (Klein et al., 2004), reduced incidence of type 2 diabetes mellitus (Knowler, Barrett-Connor, Fowler, Hamman, Lachin et al., 2002; Lindstrom, Louheranta, Mannelin, Rastas, Salminen et al., 2003; Pi-Sunyer, 2007), as well as improvement in control of diabetes (The Look AHEAD Research Group, 2007). A meta-analysis of 25 randomized controlled trials examining blood pressure found that a weight loss of 5.1 kg resulted in a 4.44 mm Hg reduction in systolic blood pressure and a 3.57 mm Hg decrease in diastolic blood pressure; significantly greater reductions in blood pressure were seen when the average weight loss was greater than 5 kg (Neter et al., 2003). However, the positive effects of weight loss on CVD risk factors do not remain unless weight loss is maintained. While serum triglyceride and LDL cholesterol levels typically decrease during the first two months of weight loss, a weight regain causes lipids to return to former levels (Wadden, Anderson, & Foster, 1999), making the prevention of weight regain imperative.

The National Weight Control Registry is an ongoing registry of individuals who have been successful at losing and maintaining a minimum of 13.6 kg for at least 1 year (Klem, Wing, McGuire, Seagle, & Hill, 1997). Many descriptive studies of this cohort have reported on behavioral strategies used by these successful individuals, including increasing physical activity, consuming a low-fat diet, regularly self-monitoring foods eaten and body weight (Wing & Hill, 2001), restricting the variety of foods eaten (Raynor, Jeffery, Phelan, Hill, & Wing, 2005), consuming a consistent weekly diet (Gorin, Phelan, Wing, & Hill, 2004), eating breakfast (Wyatt, Grunwald, Mosca, Klem, Wing et al., 2002), and limiting the amount of time spent watching television (Raynor, Phelan, Hill, & Wing, 2006). The generalizability of this

information is limited, however, by the descriptive nature of the studies and the demographics of the sample, which is 77% female and 95% Caucasian with 82% having a college education (Wing & Phelan, 2005). As a result of the rigorous methodology, the most robust empirical evidence comes from the randomized clinical trial (RCT), and the RCT is considered the second strongest level of evidence, after meta-analyses of controlled trials, in the evidence hierarchy for Evidence-Based Practice (Stetler, Brunell, Giuliano, Morse, Prince, & Newell-Stokes, 1998). Therefore, the purpose of this paper is to summarize for clinicians and researchers the strategies from RCT research of weight-loss maintenance that have been efficacious in assisting individuals in maintaining their weight after weight loss.

3.3 METHODS

In order to assess what methods have been reported as beneficial for maintaining weight loss, the existing literature was searched electronically using the databases of Medline, Allied and Complementary Medicine (AMED), Cumulative Index to Nursing & Allied Health Literature (CINAHL), and PsycINFO using the keywords *weight loss maintenance, weight loss, obesity, overweight,* and *long-term weight loss*. In addition, a hand search of pertinent articles was conducted for other relevant articles. The criteria for inclusion in the review were 1) a randomized clinical trial of a weight-loss maintenance intervention after an initial weight loss, 2) adult population (≥ 18 years of age, 1 trial > 17 years old), and 3) English language. In order to isolate the specific effect on weight-loss maintenance, only trials that used a true experimental design and randomly assigned participants to an intervention for maintenance were included. Thus, weight-loss trials with a maintenance phase that did not randomly assign participants to the

maintenance intervention were excluded. Because some early papers were identified as important in the development of knowledge related to weight-loss maintenance, papers from 1984 to 2007 were included. Subsequent articles reporting on the same intervention study were excluded. Four-hundred and eighty-two relevant articles were initially identified. Most were excluded because they did not report on a randomized clinical trial of weight-loss maintenance (n = 314). Others were excluded because the main outcome was not weight-loss maintenance, e.g. short-term weight loss, metabolic syndrome, diabetes (n = 126). Thus, 42 articles on weight-loss maintenance were included in the review. Findings from studies were organized according to the types of interventions used for weight-loss maintenance, and six categories of studies were found, those using 1) the Internet, 2) maintenance strategies after a very-low-calorie diet, 3) pharmacotherapy, 4) behavior therapy, 5) physical activity, and 6) alternative therapies. Most trials required that participants lost at least 5% of initial body weight during the weight-loss period before being randomized to the weight-loss maintenance intervention, although one medication trial required only a 2% weight loss (Wirth & Krause, 2001). Measures of the principal outcome of interest, weight change (continued loss, maintenance, or regain), were expressed in 1) absolute weight change (kg or lbs) or percentage of weight loss from the completion of the weight-loss period to the completion of the maintenance intervention or 2) from prior to weight-loss treatment to the end of maintenance or follow up based on the reporting of the article. In order to determine the magnitude of the treatment effect for each study, effect sizes (ES) were calculated by converting the p-value to a z-score and using the equation, ES = Φ = Z / $n^{1/2}$, unless a p-value was not reported, then the Cohen's *d* was determined from the difference between the two group means divided by the pooled standard deviation for those means (Cohen, 1988).

3.4 FINDINGS

3.4.1 Internet

Technological advances have permitted the use of less traditional methods for encouraging weight-loss maintenance. The four randomized trials listed in Table 3.1 used the Internet as an innovative strategy to assist participants in sustaining their lost weight. In general, these studies compared the use of an Internet-based weight-loss maintenance intervention with online chat room sessions to in-person group behavioral therapy sessions after a behavioral weight-loss trial (Harvey-Berino, Pintauro, Buzzell, & Gold, 2004; Harvey-Berino, Pintauro, Buzzell, DiGiulio, Casey Gold et al., 2002a; Harvey-Berino, Pintauro, & Gold, 2002b; Wing, Tate, Gorin, Raynor, & Fava, 2006). Results were mixed, and two studies found no difference in weight-loss maintenance between groups, suggesting that a behavioral intervention conducted over the Internet may be as effective as in-person without the higher cost of conducting face-to-face treatment (Harvey-Berino et al., 2004; Harvey-Berino, Pintauro, & Gold, 2002b). Harvey-Berino et al. (2004) found the program via the Internet resulted in long-term weight losses similar to in-person programs. In an earlier trial by this group, all persons continued to lose weight during weight maintenance despite no significant differences between groups (Harvey-Berino, Pintauro, & Gold, 2002b). However, a comparison of Internet treatment to minimal and frequent in-person treatment found that the Internet group maintained significantly less weight at the end of the trial than the in-person groups, $p < .05$; weight maintenance differences were observed between the different types of participant contact rather than the different intensities of contact (Harvey-Berino, Pintauro, Buzzell et al., 2002a). Similarly, after controlling for percent weight loss during the weight-loss trial, an Internet chat room intervention was found to be less effective in

preventing weight regain than the in-person, group behavioral treatment, $p = .02$; yet, adherence to the self-regulatory behavior of weighing oneself was significantly related to maintaining weight loss, $p < .001$ (Wing et al., 2006).

3.4.2 Very-Low-Calorie Diet (VLCD)

Nineteen reviewed studies examined weight-loss maintenance trials after a VLCD and have included additional intervention strategies such as 1) medications, 2) meal replacements, macronutrient and other dietary intervention or supplementation, 3) periodic use of the VLCD or prepackaged foods, and 4) exercise. A VLCD usually provides less than 800 kcal/day in a liquid form, is medically supervised to monitor electrolyte balance, includes vitamin and mineral supplementation and has been shown to produce rapid, substantial weight loss (Wadden & Osei, 2002). However, sizable weight regain after these diets is also typical (Saris, 2001), and they may offer no long-term benefit over traditional reduced-calorie diets of ~1200-1800 kcal/day (Gilden Tsai & Wadden, 2006; Wadden, Foster, & Letizia, 1994). The reviewed studies began with a VLCD for varying lengths of time (4 to 16 weeks) using caloric intakes ranging from 220 to 1000 kcal/day, and then participants were randomized to a weight-loss maintenance intervention. See Table 3.2.

VLCD followed by medications in maintenance

In seven trials of weight-loss maintenance after a VLCD, four types of medications were administered— orlistat, sibutramine, acarbose, or sertraline. Three studies examined orlistat (Laaksonen, Laitinen, Schonberg, Rissanen, & Niskanen, 2003; LeCheminant, Jacobsen, Hall, & Donnelly, 2005; Richelsen, Tonstad, Rossner, Toubro, Niskanen et al., 2007), a lipase inhibitor

that decreases absorption of dietary fat in the gastrointestinal tract (Drent, Larsson, William-Olsson, Quaade, Czubayko et al., 1995). Two trials investigated sibutramine (Apfelbaum, Vague, Ziegler, Hanotin, Thomas et al., 1999; Mathus-Vliegen, 2005), which suppresses appetite by inhibiting the reuptake of norepinephrine and serotonin (McNeely & Goa, 1998). The effect on weight-loss maintenance of acarbose, an oral medication to treat type 2 diabetes, and sertraline, a serotonin reuptake inhibitor, was evaluated in one study each (Hauner, Petzinna, Sommerauer, & Toplak, 2001; Wadden, Bartlett, Foster, Greenstein, Wingate et al., 1995). Two trials using orlistat versus placebo (Laaksonen et al., 2003; Richelsen et al., 2007) and one examining orlistat versus meal replacements (LeCheminant et al., 2005) found no difference in weight regain between groups at completion of the intervention. Laaksonen and colleagues found that those who lost and maintained a loss of ≥10% regained less weight during weight maintenance than those who lost less (2003). In a 3-year study where participants received orlistat or placebo, the orlistat group maintained 2.4 kg more lost weight than those receiving placebo; 67% in the orlistat group compared to 56% in the placebo group were 5% or more below baseline weight at 3 years, $p = .037$ (Richelsen et al., 2007). While all three orlistat studies used some form of a reduced-calorie diet for all participants, only the 3-year study resulted in significant differences between groups. Both sibutramine interventions were of a sizable length and found weight-loss maintenance to be superior in the sibutramine groups versus placebo (Apfelbaum et al., 1999; Mathus-Vliegen, 2005), with a greater proportion of the sibutramine group in one trial (Apfelbaum et al., 1999) maintaining a higher percentage of lost weight than the other (Mathus-Vliegen, 2005). Weight loss by VLCD was better sustained with sibutramine and reduced-calorie diet than with placebo and reduced-calorie diet (Mathus-Vliegen, 2005). Apfelbaum et al. (1999) found that those who received sibutramine continued to lose weight in the weight maintenance

period while those who received a placebo regained (Table 3.2). In terms of weight regain, there was no difference between acarbose and placebo, with both groups remaining relatively weight stable and no observed benefit from acarbose (Hauner et al., 2001). Wadden and colleagues found that the sertraline group regained more of their lost weight than placebo, p = ns, but that both groups maintained more than 8% of their original weight loss (Wadden et al., 1995).

VLCD followed by a dietary component in maintenance

Table 3.2 also lists seven trials after a VLCD that evaluated the use of a dietary intervention, macronutrients, and other dietary supplements. Treatments used included an ad lib, high-carbohydrate low-fat diet versus a calorie-restricted diet (Toubro & Astrup, 1997), green tea use (Kovacs, Lejeune, Nijs, & Westerterp-Plantenga, 2004; Westerterp-Plantenga, Lejeune, & Kovacs, 2005), increasing protein intake (Lejeune, Kovacs, & Westerterp-Plantenga, 2005; Westerterp-Plantenga, Lejeune, Nijs, van Ooijen, & Kovacs, 2004), adding fiber (Pasman, Westerterp-Plantenga, Muls, Vansant, van Ree et al., 1997), and supplementing carbohydrate intake (Pasman, Westerterp-Plantenga, & Saris, 1997). One study (Toubro & Astrup, 1997) tested the effect of an ad lib, high-carbohydrate, low-fat diet compared to a reduced-calorie diet (1875 kcal/day) that utilized color-coded cards to represent food groups and calorie content; the ad lib group regained less weight. Consumed calories from fat were higher in the reduced-calorie group compared to the ad-lib group, suggesting that eating a lower-fat diet could be important in weight-loss maintenance (Toubro & Astrup, 1997). The effect of a green tea-caffeine mixture on weight-loss maintenance appears to be contingent upon the individual's baseline level of caffeine intake. For example, Kovacs et al. (2004) found no difference in weight regain between the green tea and placebo groups until the sample was divided into low (< 300 mg) and high (> 300 mg) caffeine consumers for the analysis; the high caffeine consumers regained more weight than the

low caffeine consumers, $p < .05$. A later study by the same investigators reported that the percentage of weight regained was significantly less in the group who received the green tea mixture & had consumed low levels of caffeine at baseline, $p < .01$, suggesting a possible maximum effect of caffeine on weight management and thermogenesis (Westerterp-Plantenga et al., 2005). Increased protein intake resulted in less weight regain in two studies testing the effect of 30 g/day (Lejeune et al., 2005) and 42.8 g/day (Westerterp-Plantenga et al., 2004) of added protein. Although both studies were relatively short in duration (see Table 3.2), both reported increased satiety in the participants receiving additional protein, with those who received the higher amount of protein regaining 50% less weight than the placebo group (Westerterp-Plantenga et al., 2004). In both studies, the actual consumption of protein was 18% of calories in the protein groups compared to 15% of calories from protein in the control groups (Lejeune et al., 2005; Westerterp-Plantenga et al., 2004). Neither the trial examining the effect of supplementing fiber (Pasman, Westerterp-Plantenga, Muls et al., 1997a) nor the evaluation of added carbohydrate with fiber, caffeine, and chromium picolinate (Pasman, Westerterp-Plantenga, & Saris, 1997b) found any difference in amount of weight regained between the intervention and control groups.

VLCD followed by VLCD use in maintenance

The results of three studies that included the occasional use of a VLCD during maintenance or provided foods after VLCD-induced weight loss indicated that weight regain was similar among the randomized groups (Agras, Berkowitz, Arnow, Telch, Marnell et al., 1996; Lantz, Peltonen, Agren, & Torgerson, 2003; Ryttig, Flaten, & Rossner, 1997). For example, the group who received a late afternoon 239 kcal reconstituted drink, as part of a reduced-calorie diet to prevent overeating in the evening, regained a similar amount of weight as the reduced-calorie

diet only group. Weight maintenance after 24 months was the same for all groups whether or not a VCLD was included in the maintenance phase (Ryttig et al., 1997). An examination of two methods of using a VLCD for weight maintenance determined that weight regain was similar between those who used a VLCD intermittently and those who used a VLCD as needed, i.e., when their weight exceeded the end of weight-loss treatment weight by 3 kg; yet, clinically significant weight losses were maintained in a majority of both groups after two years of continued VLCD use (Lantz et al., 2003). Table 3.2 shows that participants randomized to one of four treatment groups to examine the effect of limiting food variety with pre-packaged meals and individualizing the pace of solid food reintroduction after a VLCD were not significantly different in weight-loss maintenance at the end the trial (Agras et al., 1996).

VLCD followed by physical activity in maintenance

Two randomized trials of weight-loss maintenance explored the role of physical activity after a VLCD (Borg, Kukkonen-Harjula, Fogelholm, & Pasanen, 2002; Fogelholm, Kukkonen-Harjula, & Oja, 1999). The trial conducted in only women compared a control group (no increase in exercise) to a walking group with a caloric expenditure goal of 1,000 kcal/week and a walking group with a goal of expending 2,000 kcal/week (Fogelholm et al., 1999). The other trial enrolled only male participants and randomized participants to resistance training, or walking, or control (Borg et al., 2002). Both studies offered counseling to follow a low-fat diet. Although neither study found a difference between groups in weight regain at the completion of the trial (Table 3.2), adherence to the exercise prescription was negatively correlated with weight gain (r = -0.43, $p < .01$), and resistance training reduced the regain of body fat mass in the sample of men (Borg et al., 2002). In the trial with women, a higher number of daily steps was significantly associated with weight-loss maintenance, and slightly better maintenance in the 1,000 kcal/week

group suggests that a moderate exercise prescription was easier to follow (Fogelholm et al., 1999).

3.4.3 Pharmacotherapy

Table 3.3 lists the seven trials that used medication, either sibutramine (Early, Apovian, Aronne, Fernstrom, Frank et al., 2007; James, Astrup, Finer, Hilsted, Kopelman et al., 2000; Wirth & Krause, 2001) or orlistat (Davidson, Hauptman, DiGirolamo, Foreyt, Halsted et al., 1999; Hill, Hauptman, Anderson, Fujioka, O'Neil et al., 1999; Karhunen, Franssila-Kallunki, Rissanen, Valve, Kolehmainen et al., 2000; Sjöström, Rissanen, Andersen, Boldrin, Golay et al., 1998), with dietary instructions or dietary support in randomized maintenance interventions following a drug therapy weight-loss trial. Two sibutramine studies compared a 15mg/day dose to placebo (Early et al., 2007; Wirth & Krause, 2001), and one trial used 10 mg/day, which could be increased to a maximum of 20 mg/day if additional weight gain occurred (James et al., 2000). All three sibutramine studies found the drug to be superior in sustaining weight loss when compared to placebo (Early et al., 2007; James et al., 2000; Wirth & Krause, 2001). No difference was found between groups who received a continuous or periodically interrupted dose, $p = .28$ (Wirth & Krause, 2001). However, one trial compared sibutramine and meal replacements to placebo and a traditional, reduced-calorie diet, making it difficult to discern which element of the drug therapy arm contributed to the efficacy of the intervention. Of note, a higher proportion of black participants in this trial failed to meet the eligibility criteria for the maintenance phase of a ≥ 5% weight loss (Early et al., 2007). The four orlistat studies all used 1-year maintenance interventions and found the medication to be more efficacious for promoting weight-loss maintenance than placebo (Davidson et al., 1999; Hill et al., 1999; Karhunen et al.,

2000; Sjöström et al., 1998). Participants who received continuous treatment with orlistat 120 mg/TID for 2 years (during weight loss and during weight maintenance) experienced the least amount of regain (Karhunen et al., 2000). Administering higher doses resulted in less regain (Davidson et al., 1999; Hill et al., 1999). In fact, Hill and colleagues found that a higher proportion of the group that received orlistat 120 mg TID regained ≤ 25% of their body weight compared to placebo, $p < .001$ (1999).

3.4.4 Behavior Therapy

Ten studies used some form of a behavioral therapy in randomized trials for weight-loss maintenance. (Table 3.4). Perri and colleagues conducted five such studies between 1984 and 2001 in an effort to improve maintenance after behavioral weight-loss treatment. Early research by these researchers found weight regain to be attenuated by forming peer social support groups and receiving weekly therapist phone calls, $p < .01$ (Perri, McAdoo, Spevak, & Newlin, 1984a), continued interventionist contact via mail and telephone, $p < .05$ (Perri, Shapiro, Ludwig, Twentyman, & McAdoo, 1984b), particularly when combined with behavioral and problem-solving therapy during weight loss compared to behavior therapy only, $p < .05$ (Perri, McAdoo, McAllister, Lauer, & Yancey, 1986), and including more treatment components in the intervention, i.e., behavior therapy, therapist contact, aerobic exercise, and social support $p < .01$ (Perri, McAllister, Gange, Jordan, McAdoo et al., 1988). More recent findings by Perri et al. (2001) indicate that problem-solving therapy is significantly better at promoting weight maintenance compared to a no-contact control condition over a one-year maintenance period, $p < .05$. These results also suggest that problem-solving therapy may be superior to relapse-prevention training in longer-term maintenance (11-17 months), $p = .013$ (Perri et al., 2001). The

sessions for the relapse-prevention training groups included didactic lectures designed to train participants in specific maintenance skills. The problem-solving therapy group meetings did not include didactic material but centered on therapist-led group discussions about solutions to participant-introduced weight management issues. The finding of an improved outcome in the problem-solving therapy group suggests that participants may have benefited more from the group discussions and less instructive methods.

Building on the results of Perri and colleagues, other researchers have investigated continued participant contact for weight maintenance with less definitive results after inpatient weight-loss treatment (Leibbrand & Fichter, 2002), using phone contact or optional pre-packaged meals (Wing, Jeffery, Hellerstedt, & Burton, 1996), and mailing personalized reports (Riebe, Blissmer, Greene, Caldwell, Ruggiero et al., 2005). In the maintenance study following 10 weeks of inpatient weight-loss treatment, the group randomized to the control condition did receive detailed materials to support long-term behavior change; some individuals also formed peer support groups (Leibbrand & Fichter, 2002). Riebe et al. (2005) mailed reports to the treatment group, individualized to the person's stage of change in the Transtheoretical Model of Health Behavior Change, but this did not influence weight maintenance as the treatment and control groups both regained about 3 kg (Riebe et al., 2005). See Table 3.4. Two studies by Wing and colleagues were published together (1996). In the first study, weekly phone calls to the treatment group inquiring about self-weighing and self-monitoring food and exercise behaviors did not influence weight regain; however, calls were made by individuals who were unknown to the participant (Wing et al., 1996). In the second study, participants randomly assigned to the treatment group were required to purchase pre-packaged meals if they wished to use them. No difference in weight regain was observed between the treatment and control groups. Of those

who chose to purchase the food boxes, weight regain was no different, $p = .11$ (Wing et al., 1996). A study examining financial incentives for maintaining weight or for participating in weight-maintenance behaviors found that the two treatment groups were not different from the controls in the amount of weight they regained; all participants sustained about half of their lost weight (Kramer, Jeffery, Snell, & Forster, 1986). A study with African Americans that used a culturally-tailored intervention did not find a difference in weight regain between the clinic-visit-only usual care group and the two intervention arms, group counseling and staff-assisted self-help (Kumanyika, Shults et al., 2005). The average regain for all participants was minimal, but the initial weight loss achieved was only 1.2 kg. Being in the highest tertile of weight loss during the weight-loss treatment phase was the strongest predictor of overall loss and maintenance, $p = .002$ (Kumanyika, Shults et al., 2005).

3.4.5 Physical Activity and Alternative Therapies

Only two studies examined either the effect of a physical activity intervention or an alternative therapy method in randomized trials of weight-loss maintenance and are not represented in a table. While research has documented the importance of physical activity in weight loss and maintenance (Jakicic, Marcus, Gallagher, Napolitano, & Lang, 2003; Jakicic, Winters, Lang, & Wing, 1999; Perri, Martin, Leermakers, Sears, & Notelovitz, 1997; Schoeller, Shay, & Kushner, 1997; Tate, Jeffery, Sherwood, & Wing, 2007; Villanova, Pasqui, Burzacchini, Forlani, Manini et al., 2006; Wadden, Vogt, Foster, & Anderson, 1998), only one trial, not conducted after a VLCD, randomized participants to a weight-loss maintenance intervention that focused on the effect of physical activity in preventing weight regain. Leermakers and colleagues randomly assigned 67 participants to either an exercise-centered intervention or a weight-centered

intervention after a behavioral weight-loss study (1999). The weight-centered treatment focused on dealing with participant-introduced barriers to weight-loss maintenance, and the exercised-centered intervention focused on sustaining physical activity, e.g., organized biweekly exercise sessions, incentives for meeting exercise goals, and problem-solving for handling exercise lapses. While both groups regained weight during the trial and 6-month follow-up, the weight-centered group regained less weight, $p < .01$ (effect size = .31), and ate fewer calories from fat, $p < .05$ (effect size = .24), suggesting that the exercise-centered intervention might not have included enough emphasis on controlling dietary intake (Leermakers et al., 1999). The 12-week alternative therapy trial included 10 hours of group meetings and explored the effects of randomly assigning 92 participants to *qigong*, Tapas Acupressure Technique® (TAT), or a support group (Elder, Ritenbaugh, Mist, Aickin, Schneider et al., 2007). *Qigong* is an ancient Chinese healing discipline that consists of a combination of breathing, mental exercises, and physical movements. TAT merges acupressure with mental focusing to change stored energy patterns in the body. The support group reviewed handouts related to weight-loss maintenance. At the 3-month follow-up, the TAT group had regained significantly less weight (+0.1 kg) than the *qigong* group (+2.8 kg), $p < .01$ (effect size = .36), and marginally less than the support group (+1.2 kg), $p = .09$ (effect size = .24) (Elder et al., 2007).

3.5 SUMMARY OF STUDY EFFECT SIZES

Of the studies examined, 39% had fewer than 100 participants and might have been underpowered to detect a difference in treatment. Only the phone intervention study by Wing and colleagues reported a small-medium effect size of 0.30 for the difference between the

treatment and control groups (1996). Effect sizes noted in the tables ranged from a very small .01 (Ryttig et al., 1997) to a medium-large effect of .60 for the study comparing the medication sertraline to placebo (Wadden et al., 1995). This latter study reported that the difference between groups in weight regain was non-significant, although a medium-large effect size was found suggesting that a sample size of 30 participants was not large enough to detect the effect.

3.6 DISCUSSION

The findings from this review show that a limited number of interventions tested in randomized clinical trials have been successful in assisting individuals to maintain their initial weight loss after treatment. The reviewed studies suggest that promising methods for reducing weight regain include some medications, inclusion of caffeine, added dietary protein, adherence to physical activity, continued weight-loss therapist contact, consuming fewer calories from fat, and alternative strategies such as acupressure. A small number of studies detected a significant influence on weight regain. Maintenance of lost weight is a complex undertaking, and long-term data on weight-loss maintenance is still lacking. Over time, it becomes increasingly difficult for persons to continue to follow the weight-management strategies learned during the course of weight-loss, and the treatment of obesity may require the use a continuous care model (Perri, Sears, & Clack, 1993) in order to help individuals sustain the lifestyle changes that promoted the initial weight loss.

Methodological limitations, e.g., small sample size, participant attrition, short treatment duration, and sample characteristics that limit generalizability, (e.g., mostly women, mostly White), suggest that replication of these clinical trials with attention to their methodological

limitations is needed. Many trials were limited by a lack of male and minority representation in the study sample. With the exception of one trial (Borg et al., 2002), the reviewed studies consisted of mostly or all women, limiting the generalizability of findings to women. One trial that enrolled nearly 50% men found that the effect of orlistat versus placebo was significant in women, but not in men over the 3 years (Richelsen et al., 2007). Few studies even reported on the ethnicity of participants, and all but one included predominantly white individuals. Early et al. (2007) found that a higher proportion of Blacks and African Americans failed to meet the eligibility criteria for randomization to the weight-maintenance intervention, ≥ 5% weight loss. The study that included only African American participants reported an overall small weight loss from pre-treatment through weight maintenance (Kumanyika, Shults et al., 2005). These two trials attest to potential ethnic differences in weight management that are not explored in trials with nearly all white participants. Another limitation of all but one of these trials (Wing, Tate, Gorin, et al., 2006) is that there was no specific identification of a theory-base for the RCT. The study by Wing and colleagues utilized self-regulation theory in the design of their intervention using the Internet to promote weight maintenance (2006), but otherwise the lack of theory-based interventions is a notable limitation to these trials.

Ten reviewed trials had attrition rates of more than 35%, complicating the interpretability of the findings and introducing the possibility of a selection bias (Ware, 2003), particularly in weight management studies where participants who have not lost/maintained weight may be more likely to drop out (Ayyad & Andersen, 2000). A strength of the randomized clinical trial is the intention-to-treat analysis, which incorporates all participants according to their randomized group assignment without consideration to withdrawal or departure from treatment (Fisher, Dixon, Herson, Frankowski, Hearron et al., 1990). However, a true intention-to-treat analysis

requires that all participants be followed to the end of the trial, which is often very difficult in longitudinal studies.

Nearly half the studies included in this review examined the efficacy of an intervention after a very-low-calorie diet. Perhaps because these diets result in greater initial weight losses in the short-term (Gilden Tsai & Wadden, 2006), several researchers have attempted to identify strategies for maintaining these significant weight reductions long term. A larger weight loss with VLCD has been found to be associated with a higher percentage of weight-loss maintenance after more than 2 years (Anderson, Konz, Frederick, & Wood, 2001), but some evidence suggests that there is a sizable variation in the percent of weight regained from initial losses at one-year (-7% to 122%) and five-year follow-up (26% to 121%) (Saris, 2001). Pharmacotherapy trials found sibutramine and orlistat to improve weight maintenance after VLCD as well as after initial treatment with the drug and a reduced-caloric intake. These medications may indeed be helpful tools in weight-loss maintenance when combined with an adjustment in dietary intake. It is important to recognize the role of lifestyle modification with reduced caloric intake and increased activity in obesity treatment in combination with orlistat and sibutramine, and that these medications are not without side effects. Sibutramine is associated with elevations in blood pressure and heart rate. Orlistat, which has recently become available as an over-the-counter medication (Alli), has gastrointestinal side effects like oily stools, fecal urgency and incontinence, or reduced fat-soluble vitamin absorption (Padwal, Li, & Lau, 2003). Additionally, these medications are only approved for up to two years of ongoing use (Padwal et al., 2003), and weight regain occurs after the medication is stopped (Apfelbaum et al., 1999). A recent population-based Canadian study found that discontinuation rates in the community were much

higher for both drugs than rates observed in clinical trials, and 98% of individuals had stopped taking the medication at 2 years (Padwal, Kezouh, Levine, & Etminan, 2007).

Other treatments noted to be effective after a VLCD included a green-tea mixture, additional dietary protein, and physical activity adherence. Because the efficacy of a green-tea mix was found in only one study and only the group of participants who tended to consume lower levels of caffeine, these results should be interpreted cautiously. Yet, a large observational study over 12 years recently found increases in caffeine consumption to be associated with less weight gain (Lopez-Garcia, van Dam, Rajpathak, Willett, Manson et al., 2006). The positive (Andersen, Jacobs, Carlsen, & Blomhoff, 2006; Du, Melchert, Knopf, Braemer-Hauth, Gerding et al., 2005; Greenberg, Dunbar, Schnoll, Kokolis, Kokolis et al., 2007) and negative effects (Du et al., 2005; James, 2004; Riksen, Zhou, Oyen, Jaspers, Ramakers et al., 2006) of caffeine on health have been debated. Consequently, the use of increased caffeine for weight-loss maintenance may be controversial.

The addition of protein to dietary intake resulted in less body weight regain, consisting of only fat-free mass, even when physical activity levels were similar between groups. The level of satiety was also higher in the group that consumed more protein, although actual dietary intake did not differ (Westerterp-Plantenga et al., 2004). While others have documented that higher protein diets resulted in greater weight loss in the short term (Due, Toubro, Skov, & Astrup, 2004; Foster, Wyatt, Hill, McGucki, Brill et al., 2003; Samaha, Iqbal, Seshadri, Chicano, Daily et al., 2003), the long-term effectiveness of this eating plan has not been well documented. The two protein trials examined here were three or six months in length; thus, additional exploration of the role of higher protein intake in the long-term is necessary.

The reviewed studies of physical activity and weight maintenance after weight loss via VLCD did not report a difference in regain between randomized treatment groups. However, higher levels of physical activity, i.e., estimated total energy expenditure (Borg et al., 2002) and daily steps taken (Fogelholm et al., 1999), were associated with improved maintenance. The exercised-focused intervention that followed behavioral weight-loss treatment found the exercise-group had a poorer outcome compared to the weight-focused group; however, there were no differences between the two groups in 24-hour estimated energy expenditure, as measured by accelerometer (Leermakers et al., 1999). This suggests that the group that was intended to have a greater emphasis on exercise perhaps, in reality, did not. In fact, inadequate adherence to the physical activity protocol may be a key reason why randomized trials frequently fail to find a relationship between physical activity and weight maintenance (Wing, 1999). The important role of physical activity in weight maintenance has been well documented (Donnelly, Smith, Jacobsen, Kirk, Dubose et al., 2004; Jakicic & Otto, 2005; Schoeller et al., 1997; Villanova et al., 2006; Wadden et al., 1998), with particular emphasis placed on the value of long-term adherence to physical activity (Pronk & Wing, 1994). Current recommendations for maintaining lost weight in adults include participation in a minimum of 60 to 90 minutes of moderate-intensity activity each day (Haskell, Lee, Pate, Powell, Blair et al., 2007), a level of physical activity that may be difficult for many individuals to achieve and or maintain.

The reviewed behavioral weight-loss maintenance interventions showed that maintaining contact with participants was influential in reducing weight regain. While ongoing communication with participants was beneficial for sustaining weight loss (Perri et al., 1986; Perri, McAdoo et al., 1984), the method of the continued contact could be important to the participants' success. For example, the telephone calls made by interviewers unknown to the

participants, not the participant's interventionist, did not result in an improved outcome (Wing et al., 1996). Additionally, using the Internet as a means of continued contact had mixed results with two studies reporting that Internet support was as effective in preventing regain as in-person contact (Harvey-Berino et al., 2004; Harvey-Berino, Pintauro, & Gold, 2002b), and two studies reporting that the Internet groups regained more weight than in-person groups (Harvey-Berino, Pintauro, Buzzell et al., 2002a; Wing et al., 2006). In fact, 70% of persons in one Internet group indicated at the 12-month assessment that they would have preferred to be in the group that met in-person (Harvey-Berino, Pintauro, Buzzell et al., 2002a), demonstrating the importance of participant acceptability of the intervention.

The findings of one reviewed study revealed that the more successful group had a lower intake of calories from fat (Toubro & Astrup, 1997). These results are supported by much of the weight-management literature (Astrup, Grunwald, Melanson, Saris, & Hill, 2000; Gerhard, Ahmann, Meeuws, McMurry, Duell et al., 2004; Howard, Manson, Stefanick, Beresford, Frank et al., 2006; Lindstrom, Peltonen, Eriksson, Louheranta, Fogelholm et al., 2006; Shick, Wing, Klem, McGuire, Hill et al., 1998). Yet, a recent 14-month study comparing the effects of a moderate-fat intake (30% of calorie intake) to a diet low in fat (20% of calorie intake) found improved long-term weight losses in the moderate-fat intake group; the authors indicated that dietary adherence in the moderate-fat group might have been easier to attain, and thus, more successful weight-loss outcomes resulted (Azadbakht, Mirmiran, Esmaillzadeh, & Azizi, 2007). Others have noted improved adherence and weight loss with a moderate-fat intake in an 18-month trial (McManus, Antinoro, & Sacks, 2001). A Cochrane Review of randomized controlled weight-loss trials of low-fat diets compared to other diets found no significant benefit of low-fat diets over other types of weight-loss diets in maintaining long-term weight loss (Pirozzo,

Summerbell, Cameron, & Glasziou, 2002). Future research should explore the role of enhanced dietary adherence and a low-fat versus moderate-fat intake for weight management.

Acupressure was shown to have efficacy as an alternative treatment for weight-loss maintenance (Elder et al., 2007). However, this study included only 43 participants and was just 12 weeks in length after 12 weeks of weight-loss treatment, a time point that coincides with typical peak weight-loss (Jeffery et al., 2000). Another trial that examined acupressure for weight loss found no significant effect (Allison, Kreibich, Heshka, & Heymsfield, 1995). This area of treatment for weight-loss maintenance is relatively unexplored and might warrant further research in larger and long-term trials (Allison, Fontaine, Heshka, Mentore, & Heymsfield, 2001; Pittler & Ernst, 2005).

3.7 IMPLICATIONS FOR NURSING

Medical care of the obese patient often includes treating obesity-related conditions like hypertension, hyperlipidemia, or type 2 diabetes mellitus without equal attention to the underlying contributing factor of weight. Assisting patients with weight-loss maintenance remains a formidable challenge for nurses as well as all health care professionals. It is imperative for nurses to understand that the clinical benefits of weight loss are only transient if the reduced weight is not maintained. Health care providers need to emphasize the favorable health effects that result from losing and maintaining a moderate 10% weight loss, and help each individual to have a realistic weight-loss goal (Klein et al., 2004). The National Heart, Lung, and Blood Institute and North American Association for the Study of Obesity have published a document specifying that a program of weight maintenance should be implemented after 6 months of

weight-loss treatment and that the practitioner has a responsibility for following the patient long term to encourage the maintenance of lost weight (2000). Nurses can make follow-up phone calls to stay in contact with and monitor the patient's progress, as this strategy was a found to be beneficial for weight maintenance. By educating themselves, their fellow health care professionals, and patients about achieving and maintaining weight loss, nurses can contribute significantly as professional role models and supportive clinicians to addressing this major health problem.

3.8 CONCLUSION

The lack of prolonged success in behavioral therapy for weight loss has been recognized for approximately 30 years (Brightwell & Sloan, 1977; Jeffery, Vender, & Wing, 1978; Stunkard & Penick, 1979). Longer weight-loss trials have helped individuals lose more weight initially (Jeffery et al., 2000), but extended maintenance of the weight loss is not necessarily realized. The reviewed studies found that weight-loss maintenance treatment with orlistat or sibutramine and dietary modification, supplementing caffeine or protein, following a lower-fat diet, adherence to physical activity, continued participant contact, problem-solving therapy, and the alternative treatment acupressure were effective in reducing weight regain after weight-loss treatment. Additional studies are needed to confirm and expand upon these findings. Future research should explore the safety and efficacy of orlistat and sibutramine beyond the 2-year time period currently approved by the Food and Drug Administration. Further investigation of innovative strategies to promote adherence to a lower dietary fat intake and physical activity will likely be beneficial in assisting with weight maintenance. Future research should determine the

most appropriate, cost-effective ways to maintain contact with and provide support to individuals in their weight maintenance efforts. Finally, the development of unexplored, novel strategies to promote weight maintenance is also imperative so that individuals are able to sustain the weight loss that they work so hard to achieve.

Table 3.1 Internet

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Harvey-Berino et al., 2002b	46 (37 women) 41 at end of trial 4% attrition "mostly White"	*3-GROUP DESIGN:* *Control* -no treatment *In-person therapist-led* *Internet therapist-led* Biweekly meetings in person or chat session with same behavioral content, self-monitoring diet & physical activity. Call or e-mail on alternate weeks.	22-week WM after 15 weeks of behavioral WL	<u>*During WM:*</u> All groups lost an average of 1.6 kg additional weight during the 22 weeks of WM with no between group differences, $p = .83$.	25% of total weight loss experienced by the total sample during the trial was lost during 15 weeks of WM	.03
Harvey-Berino et al., 2002a	122 (104 women) 90 at end of trial 26% attrition > 96% White	*3-GROUP DESIGN:* *Frequent in-person (FIP)* biweekly meetings *Minimal in-person (MIP)* monthly meetings for 6 months, then no contact *Internet support (IS)* biweekly chat sessions Same behavioral content, self-monitoring diet & physical activity. Call or e-mail on alternate weeks, FIP & IS.	1-year WM after 24 weeks behavioral WL	<u>*Prior to WL Rx through WM* [a]*:*</u> *Frequent in-person* -10.4 ± 6.3 kg *Minimal in-person* -10.4 ± 9.3 kg *Internet* -5.7 ± 5.9 kg $p < .05$ for between group differences. IS group sustained less WL than FIP & MIP.	More of the FIP & MIP groups maintained a ≥ 5% WL, $p < .02$. FIP: 84% MIP: 81.3% IS: 44.4%	.20

Table 3.1 Internet (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Harvey-Berino et al., 2004	232 (194 women) 176 at end of trial 24% attrition 100% White	*3-GROUP DESIGN* *Frequent in-person (FIP)* biweekly meetings at local interactive T.V. (ITV) studio *Minimal in-person (MIP)* monthly meetings at ITV studio for 6 months, then no contact *Internet support (IS)* biweekly chat sessions Same behavioral content, self-monitoring diet & physical activity. Call or e-mail on alternate weeks, FIP & IS.	1-year WM after 6 months behavioral WL via ITV (live group members with a televised therapist)	<u>*Prior to WL Rx through WM* [a]*:*</u> *Frequent in-person* -5.1 ± 6.5 kg *Minimal in-person* -5.5 ± 8.9 kg *Internet* -7.6 ± 7.3 kg *p* = .22 for between group differences.	<u>*Percent who maintained a ≥ 5% WL:*</u> FIP: 46% MIP: 49% IS: 62% *p* = .23 for between group differences.	.08
Wing et al., 2006	314 (255 women) 291 at end of trial 7% attrition	*3-GROUP DESIGN:* *Control* monthly informational newsletter *In-person* weekly group meetings for 1st month, then monthly; submitted weekly weights via telephone system	18-month WM-subjects had lost ≥ 10% of body weight in the previous 2 years	<u>*During WM* [a]*:*</u> *Control* +4.9 ± 6.5 kg *In-person* +2.5 ± 6.7 kg *Internet* +4.7 ± 8.6 kg *p* = .05 for difference between in-person	<u>*Percent who regained ≥ 2.3 kg*</u>: *Control* 72.4% *In-person* 45.7% *Internet* 54.8%	.11

Table 3.1 Internet (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Wing et al., 2006 (continued)	Race/ ethnicity not reported	*Internet* weekly group meetings for 1st month, then monthly via chat room; submitted weekly weights online		and control groups	p = .008 and p < .001 for difference between control & Internet and control & in-person, respectively.	

Note. WL= weight loss; WM= weight maintenance; Tx= treatment. [a]mean ± standard deviation.

Table 3.2 Treatment after a Very-Low-Calorie-Diet

Medication Use

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Richelsen et al., 2007	309 (157 women) 200 at end of trial 35% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Orlistat 120mg TID* *Placebo* Both groups were prescribed a reduced calorie diet (-600 kcal/d); visits with dietary and lifestyle counseling every mo for 18 mo then every 3 mo thereafter	3-year WM after 8-week VLCD	*During WM [a]:* *Orlistat* +4.6 ± 8.6kg *Placebo* +7.0 ± 7.1kg *p* < .02 for group differences	*After 3 years:* *Men* Orlistat: -8.3% Placebo: -7.5%, *p* = ns *Women* Orlistat: -8.4% Placebo: -5.3%, *p* < .02	.13
Laaksonen et al., 2003	41 (20 women) 34 at end of trial 17% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Orlistat 120mg TID* *Placebo* Both followed a reduced-calorie and fat diet of at least 1200 kcal/d personalized according to estimated energy expenditure	1-year WM after 9-week VLCD	*Prior to WL Rx through WM [a]:* -12.6 ± 7.4 kg for entire sample with no difference between groups, *p*-value not reported	*Those who lost ≥ 10% [a]:* Weight change in the last 6 months was +0.6 ± 2.3 kg	Unable to determine from data provided.

Table 3.2 Treatment after a Very-Low Calorie-Diet (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
LeCheminant et al., 2005	147 (107 women) 92 at end of trial 41% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *2 meal replacements daily + meal plan* *Orlistat 120 mg BID + meal plan* In both groups the meal plan was to maintain weight; weekly group meetings in lifestyle modification until 26 weeks then biweekly thereafter.	36-week WM after 12-week VLCD & 4 weeks of solid foods	*Weight after WL [a]:* *Meal replacements* 85.4 ± 14.3 kg *Orlistat 120 mg* 85.7 ± 17.9 kg *Weight after WM [a]:* *Meal replacements* 88.1 ± 16.5 kg *Orlistat 120 mg* 88.5 ± 20.3 kg	*During WM:* *Men* 4.9% increase in body weight, $p < .05$ *Women* 2.4% increase in body weight, p = ns	.02
Mathus-Vliegen et al., 2005	189 (162 women) 119 at end of trial 37% attrition >98% White	*2-GROUP DESIGN:* *Sibutramine 10mg/d-* could increase to 15 mg after 6 mo if weight gain of > 3 kg *Placebo* Both groups had biweekly meetings with GP and dietitian for 2 mo, monthly until 12 mo & bi-monthly thereafter; 600 calorie-deficit/d	18-month WM after 10-week VLCD & 2 weeks of including solid foods	*Prior to WL Rx through WM [a]:* *Sibutramine* -10.7 ± 0.5 kg or -10.3 ± 7.0% *Placebo* -8.5 ± 8.1 kg or -7.9 ± 7.3%	*During WM:* *Sibutramine* +4.1 kg or 4.5% *Placebo* +6.7 kg or 7.6% p = .004 for between group differences	.21

Table 3.2 Treatment after a Very-Low Calorie-Diet (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Apfelbaum et al., 1999	160 (127 women) 108 at end of trial 32% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Sibutramine 10mg/d* *Placebo* Both groups had dietary counseling to consume 20-30% less total calories than pre-weight loss intake; individual meeting with dietician every 3 months; assessments monthly	1-year WM after 4-week VLCD	<u>During WM[a]:</u> *Sibutramine 10mg/d* -5.2 ± 7.5 kg *Placebo* +0.5 ± 5.7 kg *p* = .004 for group differences	*Sibutramine* 75% of group sustained ≥ 100% of lost weight *Placebo* 42% of group sustained ≥ 100% of lost weight *p* = .004 for group differences	.23
Hauner et al., 2001	110 (84 women) 75 at end of trial 29% attrition 100% White	*2-GROUP DESIGN:* *Acarbose 50-300 mg/d* titrated weekly; 59.3% of group took 300 mg *Placebo* Both groups were advised to follow a personalized WM diet	26-week WM after 12-week VLCD	<u>During WM:</u> *Acarbose* no weight gain *Placebo* +0.6 kg *p* = .38 for group differences	*Acarbose* No weight change *Placebo* 6% regain of lost weight	.09

Table 3.2 Treatment after a Very-Low Calorie-Diet (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Wadden et al., 1995	53 (all women) 30 at end of trial 43% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Sertraline 200mg/d* *Placebo* Both groups received a relapse prevention training program in weekly group meetings for 4 weeks & biweekly for 50 weeks	54-week WM after 26-week WL Rx with VLCD and behavior therapy	<u>*During WM*[a]*:*</u> *Sertraline* +17.7 ± 10.6 kg regained of the 26.3 ± 7.6 kg original loss *Placebo* +11.8 ± 9.0 kg regained of the 23.4 ± 7.8 kg original loss *p* = ns for between group differences	*Sertraline* 70.9 ± 41.7%[a] of lost weight regained *Placebo* 46.5 ± 34.6%[a] of lost weight regained	.60
		<u>Dietary, Macronutrient, and Other Supplementation</u>				
Toubro & Astrup, 1997	43 (39 women) 37 eligible for WM 34 at end of trial 21% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Ad lib* 55% carb, 20-25% fat diet; 24-pg dietary booklet *Reduced-calorie* 7.8 MJ/d (1875 kcal) using 144 color-coded cards to represent foods, each card = 65.2 kcal Both groups had 2-3 group meetings a month for 6 mo, then monthly	1-year WM after 8 weeks VLCD with 1 year follow-up	<u>*During WM:*</u> *Ad lib* +0.3 (95% CI, -3.0 to 3.6) kg regained *Reduced-calorie* +4.1 (95% CI, 1.2 to 6.9) kg regained *p* = .08 for a group difference	<u>*After 1 yr f/u:*</u> *Ad lib* +5.4 (95% CI, 2.3 to 8.6) kg of initial 13.5 kg WL regained (40%) *Reduced-calorie* +11.3 (95% CI, 7.1 to 15.5) kg of initial 13.8 kg WL regained (82%) *p* = .03 for a group difference	.29

Table 3.2 Treatment after a Very-Low Calorie-Diet (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Pasman et al., 1997a	39 (all women) 31 at end of trial 20% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Fiber 10 mg BID* 10 g guar gum BID *Control* Both groups had no dietary restrictions or physical activity advise; assessments at 2, 8 & 14 months with 3-day food diaries of food intake	14-month WM after 2-month VLCD	<u>*During WM*[a]*:*</u> *Group A* (consumed > 80% of fiber) +65 ± 65% regain of lost weight *Group B* (consumed 50-80% of fiber) +123 ± 63% regain of lost weight *Control* +61 ± 66% regain of lost weight	*Group A* 6/10 persons regained ≥ 50% *Group B* 9/10 persons regained ≥ 50% *Control* 7/11 persons regained ≥ 50%	.33
Pasman et al., 1997b	39 (all women) 33 at end of trial 15% attrition Race/ ethnicity not reported	*3-GROUP DESIGN:* *50 g carbohydrate + 200 µg chromium-picolinate + 20 g fiber + 100 mg caffeine (CHO+)* *50 g carbohydrate (CHO)* *Control* Both groups followed an ad lib diet; assessments at 4, 10 & 16 mo with 3-day food diaries of food intake	16-month WM after 2- month VLCD	<u>*During WM*[a]*:*</u> *(CHO+)* 51.1 ± 109.0% regain of lost weight *(CHO)* 68.1 ± 55.2% regain of lost weight *Control* 85.5 ± 55.8% regain of lost weight	*(CHO+)* 31% regained < 50% of lost weight *(CHO)* 36% regained < 50% of lost weight *Control* 21% regained < 50% of lost weight	CHO+ vs. Control = .40 Control vs. CHO = .31 CHO+ vs. CHO = .20

Table 3.2 Treatment after a Very-Low Calorie-Diet (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Kovacs et al., 2004	104 (78 women) 104 at end of trial No attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Green tea 450 mg/d* 2 capsules with each meal *Placebo* No dietary or activity instructions specified	13-week WM after 4-week VLCD	<u>During WM [a]:</u> *Green tea 450 mg/d* 30.5 ± 61.8% regain of lost weight *Placebo* 19.7 ± 56.9% regain of lost weight *p* = ns for group differences	*High-caffeine consumer who received green tea* +39 ± 17%[a] *Low-caffeine consumer who received green tea* +16 ± 11%[a] *p* < .05 for group differences	.18
Westerterp-Plantenga et al., 2005	76 (53 women) 76 at end of trial No attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Green tea-caffeine mix (150 mg caffeine/d)* 2 capsules with each meal *Placebo* Randomized after stratification for high caffeine (HC) intake (> 300 mg/d) and low caffeine (LC) intake (< 300 mg/d); food intake not assessed	3-month WM after 4-week WL	<u>During WM:</u> Weight loss continued in the green-tea group with low caffeine intake and increased in both the placebo group with low caffeine intake as well as the green-tea group with high caffeine intake, *p* < .01 for group differences.	*Green tea + LC* -11.1 ± 24.3%[a] weight loss *Placebo + LC* +40.8 ± 38.9%[a] weight regain *Green tea + HC* +24.4 ± 18.7%[a] weight regain	.30

Table 3.2 Treatment after a Very-Low Calorie-Diet (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Westerterp-Plantenga et al., 2004	148 ("women & men") 148 at end of trial No attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Added protein* 48.2 g/d as 2 drinks *Control* Both groups followed an ad lib diet, counseling as needed from dietician	3-month WM after 4-week VLCD	<u>*During WM*[a]*:*</u> *Added protein* 17.3 ± 60.3% regain of lost weight *Control* 36.6 ± 46.8% regain of lost weight $p < .05$ for group differences	50% less weight regained in added protein group compared to control	.16
Lejeune et al., 2005	120 ("women & men") 113 at end of trial 6% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Added protein* 30 g/d as 1 drink *Control* Both groups had monthly visits for 6 mo; allowed to eat usual diet; counseling as requested from dietician	6-month WM after 4-week VLCD	<u>*During WM*[a]*:*</u> *Added protein* 19.6 ± 82.1% regain of lost weight *Control* 54.9 ± 65.8% regain of lost weight $p < .05$ for group differences	<u>*Net weight loss after WM compared to pre-VLCD:*</u> *Added protein* -6.7 ± 7.2%[a] *Control* -3.8 ± 4.8%[a] $p < .05$ for group differences	.18

Table 3.2 Treatment after a Very-Low Calorie-Diet (Continued)

VLCD Use

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Ryttig et al., 1997	81 (44 women) 76 eligible for WM 42 at end of trial 45% attrition Race/ ethnicity not reported	*3-GROUP DESIGN:* *1600 kcal/d diet for WL & WM (A)* *1600 kcal/d diet with 239 kcal of VLCD in WM (B)* *1600 kcal/d diet in WM (C)* All were instructed to maintain same level of physical activity; monthly assessments for 7 months then every 7 weeks	24-month WM after 2-month VLCD or 1600 kcal/d diet	*Prior to WL Rx to trial end[a]:* -10.9 ± 10.2 kg in all groups *Weight at end of Rx[a]:* *Group A* 110.7 ± 17.4 kg *Group B* 107.3 ± 15.1 kg *Group C* 107.5 ± 16.9 kg NS group differences	*Group A* -7% overall *Group B* -10% overall *Group C* -9.5% overall	A vs. B = .21 A vs. C = .19 B vs. C = .01
Lantz et al., 2003	334 (248 women) 117 at end of trial 65% attrition Race/ ethnicity not reported	*3-GROUP DESIGN:* *Intermittent VLCD* Repeat VLCD for 2 weeks every 3rd month *On-demand VLCD* Use VLCD when weight surpasses 3 kg above weight after VLCD Both had appointments biweekly for 6 months then monthly thereafter	2-year WM after 16-week VLCD	*Prior to WL Rx to trial end[a]:* *Intermittent VLCD* -6.2 ± 9.5% *On-demand VLCD* -7.7 ± 8.4% $p < 0.001$ for significant loss over time; p = ns for group differences	*Intermittent VLCD* 44% maintained a ≥ 5% weight loss *On-demand VLCD* 62% maintained a ≥ 5% weight loss	.17

Table 3.2 Treatment after a Very-Low Calorie-Diet (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Agras et al., 1996	194 (all women) 174 at end of trial 10% attrition Race/ ethnicity not reported	*4-GROUP DESIGN:* *Standard food + time dependent (S + T)* Regular food started 1 meal at a time at set intervals over 4 weeks *Standard food + weight dependent (S + W)* Regular food started only when weight stable over 1-3 months *Pre-packaged food + time dependent (P + T)* Prepackaged meals started 1 meal at a time at set intervals over 4 weeks *Pre-packaged food + weight dependent (P + W)* Prepackaged meals started only when weight stable over 1-3 months All received group behavior therapy in weekly meetings for 3 months, biweekly meetings for 3 months and monthly thereafter	9-month WM after 12-week VLCD with follow up 9 months after WM	<u>*Prior to WL Rx to trial end*[a]*:*</u> *S + T* -8.2 ± 12.3 kg *S + W* -8.6 ± 11.4 kg *P + T* -6.0 ± 11.1 kg *P + W* -2.8 ± 18.3 kg *p* = ns for group differences	No significant differences in percent weight regain among the 4 groups after VLCD.	S+T vs. S+W = .03 S+T vs. P+T = .19 S+T vs. P+W = .35 S+W vs. P+T = .23 S+W vs. P+W = .38 P+T vs. P+W = .21

Table 3.2 Treatment after a Very-Low Calorie-Diet (Continued)

Physical Activity

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Fogelholm et al., 1999	82 (all women) 80 at end of trial 2% attrition Race/ ethnicity not reported	*3-GROUP DESIGN:* *Walk 1* Use 1000 kcal/week walking *Walk 2* Use 2000 kcal/week walking *Control* No walking program All receive a low-fat diet, weekly group meetings, monthly materials on a healthy diet, pedometers	40-week WM after 12-week VLCD	*During WM[b]:* *Walk 1* -0.7 (1.0) kg *Walk 2* +0.2 (0.9) kg *Control* +1.7 (0.8) kg *p* = .18 for group differences	Not reported	.15
Borg et al., 2002	90 (all men) 82 at end of trial 9% attrition Race/ ethnicity not reported	*3-GROUP DESIGN:* *Walking* 45-min sessions 3 times/week *Resistance training* 45-min sessions 3 times/week *Control* No increase in activity All received a low-fat, ad-lib diet, weekly group meetings, food and exercise diaries	6-month WM after 2-month VLCD with 23-month follow up	*During WM adjusted mean difference to control:* *Walking* +0.3 kg (95% CI, -2.2 to 2.8) *Resistance training* -1.3 kg (95% CI, -3.8 to 1.1) *p* = .25 for group differences	*At 23-month follow-up:* 47.5% of all participants regained > 10% compared to weight after WL Rx	.13

Table 3.2 Treatment after a Very-Low Calorie-Diet (Continued)

Note. CI= confidence interval; GP= general practitioner; NS= non-significant; Tx= treatment; VLCD= very-low-calorie diet; WL= weight loss; WM= weight maintenance. [a]mean ± standard deviation. [b]mean ± stand error of the mean.

Table 3.3 Pharmacotherapy

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Early et al., 2007	148 (126 women) 133 eligible for WM 60 at end of trial 55% attrition 48% White 40% Black 9% Hispanic 1.5% Asian 1.5% Other	*2-GROUP DESIGN:* *Sibutramine* 15 mg/d + 1 meal replacement & 2 low-calorie meals (~1500 kcal/d) *Placebo* 3 low-calorie meals (~1500 kcal/d) Both received behavior therapy with self-monitoring, problem solving, social support	9-month WM after 3 months WL with sib. 10 mg/d and low-calorie diet	<u>*During WM* [b]*:*</u> *Sibutramine* -2.5 ± 0.6 kg *Placebo* +2.9 ± 0.6 kg *p* < .001 for group difference	<u>*During WM* [b]*:*</u> *Sibutramine* -2.9 ± 0.7% *Placebo* +3.3 ± 0.7% *p* <.001 for group difference	.28
Wirth & Krause., 2001	1102 1001 eligible for WM (768 women) 787 at end of trial 21% attrition 99.5% White	*3-GROUP DESIGN:* *Sibutramine ongoing* 15mg/d for 44 wks *Sibutramine periodic* 15mg/d except for weeks 13-18 and 31-36 when placebo was received *Placebo* All received dietary advice; no formal dietary or behavior therapy	44-week WM after 4 weeks WL with sib. 15 mg/d	<u>*During WM:*</u> *Sib. ongoing* -3.8 kg (95% CI, -4.4 to -3.2) *Sib. periodic* -3.3 kg (95% CI, -3.9 to -2.6) *Placebo* +0.2 kg (95% CI, -0.6 to 0.94)	<u>*During WM:*</u> *Sib. ongoing* Lost an additional 4% *Sib. periodic* Lost an additional 3.5% *Placebo* Regained 0.2%	.10

Table 3.3 Pharmacotherapy (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Comment*
James et al., 2000	605 467 eligible for WM (390 women) 261 at end of trial 44% attrition 96.5% White	*2-GROUP DESIGN:* *Sibutramine* 10mg/d (increased up to 20mg/d if regain) *Placebo* Both groups received dietary counseling each month or every 2 weeks if desired	18-month WM after 6-month WL with sib. 10 mg/d	*Prior to WL Rx to trial end* [a]*:* *Sibutramine* -8.9 ± 8.1 kg *Placebo* -4.9 ± 5.9 kg *p* <.001 for group difference	*Sibutramine* 43% sustained at least 80% of lost weight. *Placebo* 16% sustained ≥ 80% of lost weight *p* <.001 for group difference	.15
Sjöström et al., 1998	688 (567 women) 526 eligible for WM 435 at end of trial 17% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Orlistat* 120 mg/TID *Placebo* Both groups were to follow a weight-maintenance diet; received either orlistat or placebo during WL	1-year WM after 1-year WL with orlistat 120 mg/TID or placebo	*During WM:* *Orlistat in WL* orlistat regained 2.4 [SE 0.6] kg less than placebo, *p* <.001 *Placebo in WL* orlistat lost 3.6 [SE 0.6] kg versus placebo, *p* <.001	*After 2 years:* *Continuous orlistat* 57.1% maintained a WL > 5% *Continuous placebo* 37.4% maintained a WL > 5%	.14

Table 3.3 Pharmacotherapy (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Davidson et al., 1999	1187 880 eligible for WM (741 women) 403 at end of trial 54% attrition 81% White 15% Black 4% Hispanic	*4-GROUP DESIGN:* Orlistat-treated group rerandomized for WM *Orlistat 120 mg TID* *Orlistat 60 mg TID* *Placebo* All followed a WM diet; 4 seminars on strategies for WM; instruction in self-monitoring food intake and activity	1-year WM after 1-year WL with orlistat 120 mg/TID or placebo	<u>*During WM* [b]*:*</u> *Orlistat 120 mg* +3.2 ± 0.45kg *Orlistat 60 mg* +4.3 ± 0.57kg *Placebo* +5.6 ± 0.42kg Orlistat 120 mg regained less weight than other groups, *p* <.001	<u>*During WM:*</u> *Orlistat 120 mg* 35.2% of lost weight regained *Orlistat 60 mg* 51.3% of lost weight regained *Placebo* 63.4% of lost weight regained	.11
Hill et al., 1999	1313 (605 women) 726 eligible for WM 537 at end of trial 26% attrition 88% White 6% Black 5% Hispanic 1% Other	*4-GROUP DESIGN:* *Orlistat 120 mg TID* *Orlistat 60 mg TID* *Orlistat 30mg TID* *Placebo* All followed a WM diet; behavioral & dietary counseling; visits biweekly for 1 mo, monthly until month 5, & bimonthly thereafter.	1-year WM after 1-year WL with a 1000 kcal/d deficit diet	<u>*Prior to WL Rx to trial end* [b]*:*</u> *Orlistat 120 mg* -8.20 ± 0.5% *Orlistat 60 mg* -6.66 ± 0.5% *Orlistat 30 mg* -5.94 ± 0.6% *Placebo* -6.42 ± 0.7%	<u>*Percent who regained ≤ 25% of lost weight:*</u> *Orlistat 120 mg* 47.5% *Orlistat 60 mg* 30.4% *Orlistat 30 mg* 32.3% *Placebo* 29.9%	.12

Table 3.3 Pharmacotherapy (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Karhunen et al., 2000	96 88 eligible for WM 72 at end of trial (59 women) 18% attrition Race/ ethnicity not reported	*2-GROUP DESIGN: Orlistat (O)* 120 mg TID *Placebo (P)* TID Groups were prescribed a WM diet; because of assignment during WL, 4 groups resulted after WL & WM: O+O, O+P, P+O, P+P	1-year WM after 1-year WL with either orlistat 120 mg TID or placebo TID	*<u>Weight after WL[a]:</u>* *O+O* 82.6 ± 11.4kg *O+P* 87.7 ± 14.2kg *P+O* 89.2 ±1 9.0kg *P+P* 88.2 ± 15.8kg *<u>Weight after WM [a]:</u>* *O+O* 85.7 ± 12.4kg *O+P* 94.0 ± 16.6kg *P+O* 89.7 ± 19.9kg *P+P* 91.7 ± 16.0kg	*<u>During WM:</u>* *O+O* 24% of lost weight regained *O+P* 48% of lost weight regained *P+O* 69% of lost weight regained *P+P* 37% of lost weight regained	.27

Note. CI= confidence interval; TID= three times a day; Tx= treatment; WL= weight loss; WM= weight maintenance. [a]mean ± standard deviation. [b]mean ± standard error of the mean.

Table 3.4 Behavior Therapy

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Perri et al., 1984a	56 (45 women) 43 at end of trial 23% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Booster* review of WL Rx strategies *Multicomponent* taught to form self-help groups, use problem-solving; weekly therapist calls and mailed in postcards of food intake/weight Both groups received 6 biweekly group sessions	1-year WM after 14-week WL with behavior therapy; follow up 6 months later	*During WM* [a]: *Booster* -4.6 ± 11.1 lbs *Multicomponent* -12.8 ± 16.0 lbs *WL at follow up* *Booster* -0.8 ± 7.9 lbs *Multicomponent* -10.0 ± 15.3 lbs	*Booster* 94% of lost weight regained *Multicomponent* 25% of lost weight regained	.39
Perri et al., 1984b	129 (115 women) 99 at end of trial 23% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Phone & mail contact (P)* therapist calls, mailed postcards of food intake, exercise & weight for 6 months *No-contact control (C)* Initial WL Rx: randomization to non-behavioral therapy (*NB*), behavior therapy (*B*) or behavior therapy + relapse-prevention training (*B+R*) resulting in 6 groups after WM, these 3 WL groups plus either contact or control in WM.	6-month WM after 15-week WL with behavior therapy; follow up 6 months later	*WL at follow up* [a]*:* *B+R: P* -22.7 ± 25.1 lbs *B+R: C* -6.5 ± 7.9 lbs *B: P* -12.7 ± 9.2 lbs *B: C* -13.8 ± 13.4 lbs *NB: P* -13.6 ± 11.0 lbs *NB: C* -6.9 ± 10.5 lbs	*Attained a net loss of ≥ 20 lbs at follow-up* *Phone & mail contact* 33.3% *No-contact control* 13.7% *p* <.05 for group differences	.17

Table 3.4 Behavior Therapy (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Perri et al., 1986	90 (76 women) 67 at end of trial 25% attrition Race/ ethnicity not reported	*2-GROUP DESIGN: Multicomponent (M)* taught to form peer groups, problem solve; mailed weekly postcards of food intake/weight; weekly call from therapist *No-contact control (C)* Initial WL Rx included randomization to behavior therapy (*B*) or behavior therapy + aerobic exercise (*B+A*) resulting in 4 groups: B+A:M, B:M, B+A:C, B:C	1-year WM after 20-week WL with behavior therapy; follow up 6 months later	<u>*Weight at end of WM*[a]</u>: *B+A:M* 82.8±13.2 kg *B:M* 85.5±16.5 kg *B+A:C* 86.2±18.5 kg *B:C* 91.6±20.1 kg <u>*Weight at 6-mo f/u*[a]</u>: *B+A:M* 84.8±13.3 kg *B:M* 86.8±17.6 kg *B+A:C* 88.3±19.4 kg *B:C* 91.3±18.7 kg	Unable to determine from information provided.	.24
Kramer et al., 1986	87 (36 women) 85 at end of treatment 2% attrition Race/ ethnicity not reported	*3-GROUP DESIGN: Skills focus + $* eating/exercise skills practice *Weight focus + $* general problem-solving, $10 withheld if any weight regain *No-contact control* For two intervention groups, $10 return of deposited money at monthly meeting.	1-year WM after 15-week WL with behavior therapy	<u>*During WM*[a]*:*</u> *Skills focus + $* +13.4 ± 10.4 lbs *Weight focus + $* +11.9 ± 12.8 lbs *No-contact control* +10.3 ± 14.5 lbs (5 lbs added to 6 self-reported weights)	<u>*% of WL maintained*[a]*:*</u> *Skills focus + $* 50.0 ± 38.3% *Weight focus +$* 59.4 ± 44.5% *Control* 48.2 ± 90.1%	Skill focus+$ vs. Weight focus+$ = .13 Skill focus+$ vs. Control = .25 Weight focus+$ vs. Control = .12

Table 3.4 Behavior Therapy (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Perri et al., 1988	123 (97 women) 91 at end of treatment 26% attrition Race/ ethnicity not reported	*5-GROUP DESIGN:* *Therapist contact (TC)* biweekly group sessions *TC + social influence (SI)* added peer-support and incentives for adherence *TC + aerobic exercise (AE)* added up to 180 min/week of aerobic activity *TC + SI + AE* all of the above *No-contact control*	1-year WM after 1-year WL with behavior therapy; follow up 6 months later	*Prior to WL Rx through f/u [a]:* *TC* -11.4 ± 12.1 kg *TC +SI* -8.4 ± 7.5 kg *TC + AE* -9.1 ± 6.4 kg *TC + SI + AE* -13.5 ± 15.2 kg *No-contact control* -3.6 ± 6.2 kg	*% of WL maintained:* *4 Rx groups* 82.7% *No-contact control* 33.3%	.27
Perri et al., 2001	88 80 at end of trial (all women) 9% attrition Race/ ethnicity not reported	*3-GROUP DESIGN:* *Relapse-prevention training* recognizing high-risk times, coping, practicing handling challenging situations *Problem-solving therapy* orienting self to problem, generating alternatives, decision making, evaluation *No-contact control* Two intervention groups attended biweekly meetings	1-year WM after 5-month WL with behavior therapy	*Prior to WL Rx through WM [a]:* *Relapse-prevention training (RPT)* -5.9 ± 6.4 kg *Problem-solving therapy (PST)* -10.8 ± 8.7 kg *No-contact control (C)* -4.1 ± 4.9 kg	*% who lost and maintained ≥ 10%* *RPT* 21.4% *PST* 35.3% *C* 5.6%	.22

Table 3.4 Behavior Therapy (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Wing et al., 1996	Study 1 53 (all women) 50 at end of trial 6% attrition Study 2 57 (no gender data) 48 at end of trial 16% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* Study 1: Telephone *Phone* weekly calls re: self-weigh or self-monitor foods and exercise *Control* no contact Study 2: Food Provision *Optional foods* monthly group meetings + optional food boxes for a fee during 4 months of WM *Control* monthly group meetings	1-year WM after 6-month WL with behavior therapy	*During WM* [a]*:* Study 1 *Phone* +3.9 ± 1.1 kg *Control* +5.6 ± 1.0 kg Study 2 *Optional foods* +4.2 ± 1.0 kg *Control* +4.3 ± 1.1 kg *p's* > .28 for group differences	Study 1 25% less weight regained in phone group compared to control Study 2 32% of lost weight regained in both groups	Study 1 = .30 Study 2 = .16
Liebbrand & Fichter, 2002	109 91 at end of trial (all women) 16% attrition Race/ ethnicity not reported	*2-GROUP DESIGN:* *Maintenance* Eight 45-min phone calls from therapist in 1st 9 months; 4 calls during 2nd 9 months *Control* no support after discharge	18-month WM after 10-week inpatient WL Rx	*Weight after WL* [a]*:* *Maintenance* 120.9 ± 23.4 kg *Control* 118.3 ± 24.4 kg *Weight after WM* [a]*:* *Maintenance* 118.7 ± 26.0 kg *Control* 118.2 ± 24.0 kg	6.3% of weight was lost and maintained by the total sample during WL and WM with no difference between groups	.02

Table 3.4 Behavior Therapy (Continued)

Study	*N*	*Treatment*	*Length of WM Tx*	*Results*	*% Weight Change*	*Effect Size*
Riebe et al., 2005	144 (112 women) 104 at end of trial 28% attrition 97% White	*2-GROUP DESIGN:* *Extended care* received 2 personalized reports in the mail at 9 and 12 mo *Control* received general materials about diet and exercise at 9 and 12 mo Both groups received same anthropometric, biochemical, and dietary variable reports at 12 and 24 months	18-month WM after 6-month WL with behavior therapy	<u>*Weight at end of WL*[a]</u>: *Extended care* 87.6 ± 15.9 kg *Control* 84.1 ± 14.1 kg <u>*Weight at end of WM*[a]</u>: *Extended care* 90.5 ± 16.9 kg *Control* 86.9 ± 15.4 kg	The total sample maintained 48% of lost weight.	.22
Kumanyika et al., 2005	128 (116 women) 87 at end of trial 32% attrition 100% African American	*3-GROUP DESIGN:* *Group counseling* 6 meetings biweekly then monthly; reviewed topics and > focus on group discussion *Staff-assisted self-help* resources to promote self-directed WM- pedometer, peer support, monthly calls *Clinic visits only* No intervention, only brief advice from MD as requested	8- to 18-month WM after 10-week WL with behavior therapy adapted for culture	<u>*During WM:*</u> *Group counseling* -0.02 kg (95% CI, -1.7 to 1.8 kg) *Staff-assisted self-help* +1.1 kg (95% CI, -0.3 to 2.5 kg) *Clinic visits only* -0.04 kg (95% CI, -1.9 to 1.8 kg) *p* =.55 for group differences	25% of the total sample lost and maintained ≥ 5% of initial weight	.05

Table 3.4 Behavior Therapy (Continued)

Note. CI= confidence interval; M= mean; Tx= treatment; WL= weight loss; WM= weight maintenance. [a]mean ± standard deviation.

4.0 RESULTS MANUSCRIPT #1

An Exploration of Racial Differences and Psychosocial Correlates of Weight Maintenance after a Behavioral Weight Loss Trial

4.1 ABSTRACT

Objective: To investigate weight maintenance after a behavioral weight loss trial and explore whether or not differences in weight maintenance existed between black and white participants. We also examined low-fat diet experiences, barriers to healthy eating, self-efficacy, social support and stress as potential correlates of weight maintenance. **Methods**: A descriptive, ancillary study, PREFER II, was conducted at 18 months after the completion of a behavioral weight loss trial, PREFER, to assess weight maintenance. Race was self-identified by participants as Black or White. We weighed participants in light clothing with no shoes using the Tanita digital scale. We used the following scales to measure psychosocial variables: Experiences Following a Low-Fat Diet (ELF), Barriers to Healthy Eating (BHE), Weight Efficacy Lifestyle and Self-Efficacy for Exercise. Social support was measured using a composite variable of two subscales from the ELF and BHE. We assessed stress from four survey items. We used hierarchical multiple linear and logistic regression models to examine the relationship of independent variables with percent weight change and unsuccessful weight

maintenance defined as > 5% weight regain. **Results**: The sample (*N*= 107, *n*= 81 White, *n*= 26 Black) was mostly female (86.0%) and married (70.8%) with a mean age of 46.3 years (*SD* = 6.9 years). After controlling for age, gender, income, education and marital status, in general there was no significant difference in percent weight change (p = .55) or unsuccessful weight maintenance (p = .53) between the black and white participants in PREFER II; black and white individuals regained a similar amount of weight (*M* = 5.0%, *SD* = 6.6% and *M* = 4.4%, *SD* = 5.6%, respectively). Percent increase in the BHE and the effect of a stressful life event on eating were significantly associated with percent weight regain and unsuccessful weight maintenance, ps < .04. **Conclusions**: A difference between black and white participants in weight maintenance was not supported. However, innovative strategies need to be developed to help all individuals overcome barriers to following a healthful eating plan and cope with stressful life events in order to minimize weight regain.

4.2 INTRODUCTION

Obesity and overweight are pandemic (Roth, Qiang, Marban, Redelt, & Lowell, 2004). Moreover, racial and ethnic minority groups like black Americans have a higher prevalence of obesity, e.g. 54% of black women are obese vs. 30.2% of white women, and are unduly burdened by the health disorders associated with these conditions, e.g. hypertension and type 2 diabetes (Must, Spadano, Coakley, Field, Colditz et al., 1999). Although weight loss treatment in the last 20 years has succeeded in promoting weight loss among those seeking to lose weight (Jeffery et al., 2000), weight maintenance after loss has remained a substantial challenge as this undertaking requires long-term adherence to the changes in lifestyle that created the initial weight loss (Perri

& Foreyt, 2004). Correlates of long-term weight maintenance after a loss have not been clearly elucidated (Anderson et al., 2001), particularly among black persons who are affected by obesity in greater numbers (Kumanyika, Gary, Lancaster, Samuel-Hodge, Banks-Wallace et al., 2005).

Very few studies have even explored weight maintenance among racial minorities; however, some differences in weight management have been reported. For example, some researchers found that while black participants tend to achieve less weight loss during treatment, the amount of regain they experienced following the loss is either the same as or less than white participants (Kumanyika, Espeland, Bahnson, Bottom, Charleston et al., 2002; Rickel, Gibbons, Milsom, DeBraganza, Murawski et al., 2007; Stevens, Obarzanek, Cook, Lee, Appel et al., 2001). Others noted that black individuals regained weight more rapidly (Wing & Anglin, 1996). A small trial examining weight maintenance in black women found that a smaller reaction to hunger and cues for eating were marginally related to weight-loss maintenance (Walcott-McQuigg, Chen, Davis, Stevenson, Choi et al., 2002). Further research is needed to investigate this crucial aspect of weight management among black persons.

Psychosocial factors contributing to unsuccessful weight maintenance may include boredom (Smith, Burke, & Wing, 2000; Wing & Jeffery, 2003), ineffective coping or problem-solving abilities (Drapkin, Wing, & Shiffman, 1995; Kayman, Bruvold, & Stem, 1990), unrealistic weight-loss goals (Cooper & Fairburn, 2001; Dalle Grave, Calugi, Molinari, Petroni, Bondi et al., 2005; Giusti, Suter, Heraief, Gaillard, & Burckhardt, 2003), and a decrease in eating restraint or an increase in disinhibition (McGuire, Wing, Klem, Lang, & Hill, 1999; Niemeier, Phelan, Fava, & Wing, 2007; Wing & Hill, 2001). A recent review of factors related to weight loss maintenance and regain reported that self-efficacy, social support, improved coping skills and ability to deal with life stress were associated with successful maintenance (Elfhag &

Rossner, 2005). While increases in self-efficacy have been linked to successful weight loss (Warziski, Sereika, Styn, Music, & Burke, 2008), some research does not support an influence of self-efficacy on weight after active treatment (Linde, Rothman, Baldwin, & Jeffery, 2006). Regarding social support, Wing and Jeffery reported a significant influence on weight loss and maintenance for the group of participants recruited with friends, but the findings were confounded by the addition of financial incentives for weight maintenance in this group (1999). Additionally, stress has been shown to have a substantial influence on eating behaviors and weight management (Crowther, Sanftner, Bonifazi, & Shepherd, 2001; DePue, Clark, Ruggiero, Medeiros, & Pera, 1995), and a high stress level at baseline was predictive of weight gain over six years (Korkeila, Kaprio, Rissanen, Koskenvuo, & Sorensen, 1998). A study with 36 African American women found that those who were more overweight reported a higher level of stress, and over 50% felt that stress negatively influenced the management of their weight (Walcott-McQuigg, 1995). The impact of stress on weight maintenance after a behavioral weight loss trial is not well documented however.

Studies have focused on continuing a low-fat diet as a means of promoting weight maintenance (Astrup et al., 2000; Lindstrom et al., 2006; Shick et al., 1998; Swinburn, Metcalf, & Ley, 2001), but continuing to consume a diet low in fat may prove difficult long-term. Some individuals feel deprived when eating a diet low in fat; yet, the development of a distaste for fat has been reported in those who are adherent to a low-fat diet, supporting the continuation of the diet long-term (Urban, White, Anderson, Curry, Kristal et al., 1992). The role of individuals' experiences when following a low-fat diet in weight maintenance has been largely unexplored, particularly among black populations.

Barriers to weight maintenance exist related to dietary intake and healthy eating (Eikenberry & Smith, 2004; Vijan, Stuart, Fitzgerald, Ronis, Hayward et al., 2005). A weight maintenance study of barriers associated with healthy food intake in women found the principle barriers to healthy eating were individual concerns related to taste, not enough time or motivation, and the belief that healthy foods were more costly (Andajani-Sutjahjo, Ball, Warren, Inglis, & Crawford, 2004). Barriers for African American women include the cost of more healthful foods (Davis, Clark, Carrese, Gary, & Cooper, 2005), traditional preparation of cultural dishes and family members' eating expectations (Airhihenbuwa, Kumanyika, Agurs, Lowe, Saunders et al., 1996; Carter-Edwards, Bynoe, & Svetkey, 1998). Barriers to healthy eating need to be further examined to determine the full effect of their influence on weight maintenance.

The aims of this study were to 1) investigate if there were differences between black and white participants in long-term weight maintenance 18 months after a behavioral weight loss trial, in terms of percent weight change and successful weight maintenance (≤ 5% regain), and 2) examine experiences associated with following a low-fat diet, barriers to healthy eating, self-efficacy for resisting eating and for exercising, social support, and stress as potential correlates of weight maintenance as well as whether or not racial group moderated the relationship of these variables with weight maintenance.

4.3 METHODS

4.3.1 Design Overview and Study Sample

This descriptive ancillary study, PREFER II, was conducted 18 months after the completion of a randomized clinical trial of behavioral weight loss treatment, PREFER. Individuals were recruited from the community for PREFER in three cohorts to participate in a year and a half trial that randomly assigned participants to receive their preferred dietary treatment or not (Preference-Yes or Preference-No) and to either a standard, reduced-calorie and reduced-fat diet or a lacto-ovo-vegetarian reduced-calorie and reduced-fat diet. Standard behavioral therapy for weight loss was used and participants met in weekly group meetings for the first 6 months, biweekly meetings for months 7-9 and monthly meetings during months 10-12. In the last 6-month maintenance phase of the trial, participants had no meetings and no contact with study personnel except to arrange the final study assessment. Detailed information regarding the design and findings of the PREFER trial have been previously published (Burke, Choo, Music, Warziski, Styn et al., 2006; Burke, Hudson, Warziski, Styn, Music et al., 2007; Burke, Styn, Steenkiste, Music, Warziski et al., 2006; Burke, Warziski, Styn, Music, Hudson et al., 2008). In summary, the mean weight loss at study end was between 4% and 8% for the four treatment groups with no significant difference in weight loss observed for individuals in the lacto-ovo-vegetarian diet groups from those in the standard diet groups; participants randomly assigned to Preference-No lost more weight than participants who were randomized to Preference-Yes (Burke, Warziski et al., 2008).

For PREFER II, we contacted participants by mail asking them to return for a follow-up assessment 18 months after they finished the PREFER trial. After two weeks of no response,

individuals were contacted by phone to request that they participate. During PREFER, participants were not informed that any type of follow-up study would take place and were not contacted prior to the letter requesting their participation in PREFER II. We collected data regarding weight and psychosocial predictors of weight maintenance (experiences associated with following a low-fat diet, barriers to healthy eating, self-efficacy for resisting eating and for exercise, stress, and social support). The inclusion criteria of the PREFER study dictated the eligibility criteria for PREFER II— persons were 18-55 years old at enrollment of the PREFER trial, agreed to be randomly assigned to their treatment preference or not and one of the two diet plans, had a BMI between 27 and 43 kg/m^2 inclusively, and had adequately completed a 5-day food intake diary. Persons were excluded from PREFER if they were diagnosed with a serious medical condition that necessitated a physician's management of diet or physical activity (e.g. diabetes, recent myocardial infarction), had physical restrictions affecting their ability to exercise, were pregnant or planning a pregnancy, were being treated for a psychological illness, reported drinking four or more alcoholic beverages daily, were currently or recently (within the past 6 months) enrolled in a weight loss program or taking weight loss medications, or reported no regular consumption of meat, fish or poultry. For PREFER II, participants needed to have completed the PREFER final assessment as this time point was the baseline of PREFER II. We conducted assessments at the School of Nursing at the University of Pittsburgh, the Clinical Translational Research Center at Montefiore University Hospital, or another location convenient for the participant such as their home or workplace. Between February 2006 and April 2007, 119 of the 132 persons (90%) in the three PREFER cohorts who completed the weight loss trial took part in PREFER II. Of those 119, two participants were pregnant and one participant revealed that she had developed a binge eating disorder; individuals who scored above a level (> 37) that

would suggest the presence of disordered eating symptoms on the Binge Eating Scale (Gormally, Black, Daston, & Rardin, 1982) were excluded from PREFER. Thus, these three individuals were excluded from PREFER II because they were not representative of the population from which the sample was to be drawn. Additionally, nine of the participants self-selected a race other than Black or African American or White (three Hispanic, three Asian, one Hawaiian Pacific, one Alaskan Native and one American Indian) and were not included in the analysis. Therefore, the total sample consisted of 107 participants, 81 white individuals and 26 black individuals.

4.3.2 Measures

The Tanita Digital Scale was used to measure weight in pounds with participants wearing light clothing and no shoes. For one out-of-town participant, we obtained a self-reported current weight. Self-reported weights have been shown to be valid in previous studies of middle-aged adults (Kuczmarski, Kuczmarski, & Najjar, 2001; Spencer, Appleby, Davey, & Key, 2002), and a 2-kg correction was added to the value to account for possible under-reporting, as others have done (Kramer et al., 1986; Linde, Jeffery, Finch, Ng, & Rothman, 2004; Palta, Prineas, Berman, & Hannan, 1982).

We measured psychosocial variables using the Experiences Associated with Following a Low-fat Diet Scale (ELF), Barriers to Healthy Eating Scale (BHE), Weight Efficacy Lifestyle Questionnaire (WEL), and Self-Efficacy for Exercise Scale (SEE). Social support was measured with a composite score of three items from the BHE scale and four items from the ELF scale that measure family and friend social support as determined by factor analysis (Burke, Kim, & Music, 2004; Kim, Burke, Music, Cartwright, Polakoski et al., 2004). Stress was assessed from

four survey items: “Have you had a major stressful event (such as marriage, new job, divorce, death in the family) in the last 18 months? If yes, please describe.” “On a scale of 0 (no effect) to 10 (most effect), how much did this stressful event affect your eating habits?” “On a scale of 0% to 100% of the time, how often does stress influence how you eat?” “On a scale of 0% to 100% of the time, how often do you use tricks to lower your stress level (deep breathing, journal writing, exercise, relaxing hobbies, time management, etc.)?” The survey was developed for PREFER II and was pilot tested in a group of women being counseled for weight loss who reported that it was easily completed. We administered the ELF, BHE and WEL in both PREFER and PREFER II while the SEE and the four survey items assessing stress were only administered in PREFER II.

The ELF is a 25-item scale developed and used in the Women’s Health Trial (Urban et al., 1992) and measured experiences believed to be associated with low-fat dietary maintenance— wellness (feeling healthier while on the diet), distaste (for fat), cost (time and money), inconvenience (adhering to the diet when not eating at home), deprivation (denied desired foods), and family (insufficient support from family). It has a 5-point scale (1 = strongly disagree to 5 = strongly agree) and was validated during the Women’s Health Trial (r = .26 to .76). Negatively worded items were reverse coded so that higher scores represent a more positive experience. Cronbach’s alpha for this study was satisfactory at .81 (Nunnally & Bernstein, 1994), similar to that of others (Kim et al., 2004).

The BHE is a 22-item scale in which participants rated various circumstances related to following the healthy eating plan (emotions, daily mechanics of following the eating plan, social support) on a scale of 1 (no problem) to 5 (very important problem). Example items include, “I have trouble estimating appropriate portion sizes” or “When I am very hungry, I have trouble

controlling what I eat." Lower scores indicated fewer barriers. A shorter version of this scale was used in a previous weight loss study (Jeffery, Wing, Thorson, Burton, Raether et al., 1993). It was expanded for the PREFER trial and psychometric testing revealed a Cronbach's alpha of .86; (Burke et al., 2004). Cronbach's alpha for the sample in this study was .89 indicating excellent internal consistency.

The WEL questionnaire is a 20-item measure to assess self-efficacy for weight management (Clark, Abrams, Niaura, Eaton, & Rossi, 1991). This scale assessed the participant's confidence in the ability to resist eating in different situations on a scale of 0-9, such as "I can resist eating when I am watching TV." Higher scores indicate higher confidence. Psychometric properties are well-established with Cronbach alpha coefficients ranging from .70 to .90 (Clark et al., 1991). Cronbach's alpha for this study was high at .94. The validity and reliability of this instrument has also been established in African American women (Dutton, Martin, Rhode, & Brantley, 2004).

The SEE scale was only administered at PREFER II and is a 9-item self-efficacy measure for exercise (Resnick & Jenkins, 2000) that asked persons to rate their confidence in their ability to exercise 3 times per week for 20 minutes given a variety of circumstances, e.g. you were busy with other activities or you felt tired. Good internal consistency has been reported with a Cronbach's alpha of .92 (Resnick & Jenkins, 2000). Cronbach's alpha coefficient for this study was similar at .93. The scale range is 0 (not confident) to 10 (very confident) and higher scores indicated greater confidence in the ability to exercise.

The items that comprised the social support variable are listed in Table 4.3. These items from the BHE and ELF questionnaires were combined as a measure of the participant's perception of their social support from family and friends for following a healthful eating plan.

Items were recoded so that a lower score indicated less social support. In this study, the Cronbach's alpha of .78 indicated satisfactory internal consistency for the social support measure.

4.3.3 Statistical Analysis

SPSS (version 15.0, SPSS Inc., Chicago, IL 2006) was used for the analysis. Descriptive statistics (means, standard deviations, medians) were used to characterize the study sample. We used data from the final PREFER assessment (considered the baseline assessment for PREFER II) and the 18-month follow-up, PREFER II. Percent change scores were calculated for all predictor variables (ELF, BHE, WEL, social support) and the continuous dependent variable (weight), with the exception of the SEE and the four stress items, as these variables were collected only at PREFER II. We calculated percent change scores as:

$$\frac{\textit{PREFER II variable - PREFER trial completion variable}}{\textit{PREFER trial completion variable}} \times 100 = \%\Delta \textit{ variable (variable change)}$$

For the binary outcome variable, the percent change in weight maintenance was dichotomized as ≤ 5% regain (successful weight maintenance, coded as 0) or > 5% regain (unsuccessful weight maintenance, coded as 1). We conducted a detailed exploratory analysis of all data using exploratory analytic techniques to assess missing data, screened for outliers, and determined whether assumptions underlying statistical tests were met. Missing data were identified and examined in SPSS; all participants and variables had < 5% missing data. Exploration of patterns of missing data revealed that data were missing completely at random, Little's MCAR test $\chi^2_{(26)} = 16.72$, $p = .92$. Two participants were missing the ELF, BHE, and

WEL at baseline; one participant was missing only the ELF at baseline; one participant was missing income and marital status data; and one participant was missing the three continuous stress items. Because such a small amount of data was missing, a listwise deletion was used and these individuals were excluded from models that included these variables. Sociodemographic variables, baseline values of the independent variables, and weight and were examined for differences between black and white participants as well as between those who returned for PREFER II and those who did not return using chi-square tests of independence and Fisher's exact tests (categorical variables) and *t*-tests or Mann Whitney U tests (continuous variables). The significance level for two-sided hypothesis testing was set at .05.

Psychosocial correlates were examined in relation to weight maintenance as a continuous (% weight change) and binary outcome variable (successful vs. unsuccessful weight maintenance) using multiple linear and multiple binary logistic regression models, respectively. Assumptions underlying multiple linear regression (normality of the residuals, homoscedasticity of error variance, independence of observations, linearity of variables, no multicollinearity, no outliers) were assessed by examining histograms and normal probability plots of the studentized residuals, scatterplots of standardized predicted values versus standardized residual values, and scatterplots of the dependent variable versus the standardized residuals. All assumptions, with the exception of no outliers, were supported, e.g., histograms of residuals approximated a bell curve (normality), plots of standardized residuals with standardized predicted values were randomly scattered around a horizontal line at zero with no discernable pattern (homoscedasticity and linearity), standardized predicted values versus the dependent variable were randomly scattered around a line (linearity). Statistical assumptions of logistic regression (independence of observations; the independent variables are linearly related to the log odds; i.e. logit, of the

dependent variable; no multicollinearity; no outliers) were also supported, with the exception of no outliers. Linearity in the logit was assessed using the Box-Tidwell Transformation test by adding to the logistic models interaction terms of the cross product between each predictor variable (age, education, % change in ELF, % change in BHE, % change in WEL, % change in social support, the three continuous stress items) and its natural logarithm. None of these interaction terms were significant (*p*s > .15); thus linearity in the logit was supported. In all logistic regression models, the reference group was the successful weight maintainers. Multicollinearity was assessed by examining the correlation matrix for all variables, variance inflation factors (VIF), tolerance and condition indices (CI). All correlations were < .80, all VIF values were < 10, all tolerance values were > .1, and all CI were < 30 satisfying the assumption of no multicollinearity (Tabachnick & Fidell, 2001). Goodness of fit for the logistic models was assessed using the Hosmer-Lemeshow (H-L) test; all models showed satisfactory fit with non-significant H-L tests (*p*s > .07) (Hosmer & Lemeshow, 2000). Diagnostics used to assess for possible outliers included examination of residual plots for data points that were far away from the distribution, standardized residuals, studentized deleted residuals, leverage values, Mahalanobis distance values, Cook's distance values, Dfbeta values, and deviance (for the logistic models). Sensitivity analyses were performed without participants who had outlying values to determine the influence of outliers on the estimation of regression coefficients and fitted/predicted values.

Predictors of interest were examined univariately first using simple linear and simple logistic regression models in order to select discriminating variables for inclusion in multivariate models. The SEE score was not a significant predictor of weight maintenance in either the simple linear or simple logistic regression models (*p*s > .76), and thus was not included in the

multivariate regression models. We built the multiple linear and logistic models hierarchically controlling for age, gender, education, income, and marital status in the first block. For the first aim of the study, to investigate if there were differences between racial groups in weight maintenance after controlling for the above covariates, a linear and logistic model included only a dummy coded variable for race in the second block. For the second aim, in another linear and logistic model, psychosocial variables of interest (ELF, BHE, WEL) were added in the second block after including sociodemographic covariates in the first block, and race was added in the third block to determine its effect on weight maintenance after controlling for other variables. Because the social support variable was derived from items in the ELF and BHE, we wished to avoid multicollinearity and built separate hierarchical linear and logistic models to examine the effect of social support, with sociodemographic covariates in the first block, social support in the second block, and the race variable added in the third block. We attempted to derive a composite stress score from the three continuous items related to stress; however, the first item was only answered by individuals who reported experiencing a stressful event in the previous 18 months (n = 69), and an exploratory factor analysis revealed that the remaining two items had a low correlation, r = -.03. Therefore, stress was examined in three linear and three logistic models with each stress item examined individually using the total sample for two items and the subsample (n = 69) for one item. Interaction terms between race and all psychosocial predictors were included in the fourth blocks of linear and logistic models to assess for possible effect modification, i.e. moderation, due to racial group; however, no interaction terms were significant (ps > .10). Thus, interaction terms were dropped from the models in the interest of parsimony, and effect modification due to racial group was not supported. Higher order effects for each predictor variable (cubic and quadratic terms) were also explored to improve fit and prediction.

Prior to creating higher order effect terms, continuous variables were centered by subtracting the mean value for the variable from each data point. The quadratic term for BHE was significant in the logistic regression model; however, after further examination of the residual plots, the curvature appeared to be the result of two outlying values. After the deletion of two additional outliers, the quadratic term was no longer significant. Please see Tables 4.8 and 4.9 for results with and without these influential outliers. Otherwise, the data did not reflect curvature in the plots, no other higher order terms were significant (all $p > .11$) and did not improve model fit.

A total of three outliers were identified that overly influenced the findings for the predictors of WEL change and BHE change; these individuals were all women and were excluded from the multivariate linear and logistic models with ELF change, BHE change, and WEL change. One 53-year-old white woman experienced a 262.0% increase in self-efficacy for resisting eating, yet she regained 6.25% of her weight and was an *unsuccessful* weight maintainer. She had a 2.91% (7.7 lbs) weight loss during PREFER and had the lowest baseline score for self-efficacy for PREFER II. Despite the sizable increase in her self-efficacy during the 18-month period, her score remained in the lowest quartile of the sample at follow-up. She experienced stressful life events that included personal illness, family stress and financial problems that had an 8/10 influence on her eating habits, on a scale of 0 (no effect) to 10 (most effect. Another 47-year-old white woman had a 126% increase in barriers to healthy eating, and regained 3.82% of her weight making her a *successful* weight maintainer. She lost only 0.96% (2 lbs) of her weight during PREFER. Her baseline PREFER II BHE score was in the bottom 20% of the sample, but increased to the highest quartile of the sample at follow up. She reported job stress as a stressful event that had a 7/10 impact on her eating habits. The third outlier, a 46-year-old black woman, experienced a 123% increase in barriers to healthy eating, but regained 4.07%

making her a *successful* weight maintainer. She had also gained weight (0.65% or 1.7 lbs) during PREFER. Her PREFER II baseline BHE score was the fifth lowest score in the sample and increased to the 50th percentile at follow up. She reported the death of a significant other under stressful events that had a 7/10 influence on her eating habits.

4.4 RESULTS

One hundred and seven black and white participants took part in PREFER II. Sociodemographic and baseline sample characteristics are noted in Table 4.4. Most individuals were female (86%), employed full time (79.1%), and highly educated (M = 15.3 years, SD = 2.6 years). There were no significant differences in sociodemographic variables between black and white participants (all $p > .11$) with the exception of marital status. There were significantly more white individuals who were married or living with a partner compared to black persons, $\chi^2_{(1)} = 10.08$, $p < .01$; therefore marital status was controlled for in the analysis. There were also no differences in baseline independent or dependent variables (ELF, BHE, WEL, social support, weight) between racial groups, all $p > .17$. For the successful and unsuccessful weight maintainers, no significant differences between the baseline independent variables were found, all $p > .06$; however, those who successfully maintained their weight weighed significantly more at baseline than those who did not (M = 201.2 lbs, SD = 30.8 lbs and M = 184.2 lbs, SD = 34.2 lbs, respectively, $t_{(105)} = 2.69$, $p < .01$). An examination of individuals who did not return for PREFER II revealed that there were no significant differences in sociodemographic (age, gender, race/ethnicity, education, income, marital status) or baseline variables (weight, ELF, BHE, WEL, social support) between those who participated in the PREFER II study and those who did not, ps > .08, supporting the

generalizability of these results to the entire PREFER sample. Additionally, there were no differences in the above variables between the nine participants who self-selected a racial group other than Black or White and those included in the analysis, all $p > .15$.

Table 4.3 shows the independent and dependent variables for the total sample and each racial group. A greater proportion of participants were successful weight maintainers (57%) compared to unsuccessful maintainers in the total sample and each group. The percent weight change for the total sample was a gain of a mean of 4.6% (SD = 5.8%), with no difference between black and white persons in either the binary outcome or the continuous outcome, ps > .65. Additionally, 57.3% of participants remained at or below what they initially weighed when they began the PREFER weight loss trial with 28.2% maintaining at least a 5% weight loss from the start of PREFER (data not shown). Most independent variables did not change much during the 18-month time frame with the exception of barriers to healthy eating, which increased by a mean of 12.7% (SD = 30.5%). This increase was similar in both black and white participants, U = 1003.0, p = .86. In fact, there were no significant differences between the two racial groups in any of the independent variables, all $p > .12$. For the total sample and both racial groups, the mean percentage of the time that stress influenced eating habits was over 53%, yet the mean percentage of the time participants utilized techniques to reduce stress was less than 39% of the time. For the subsample of 69 individuals who experienced a stressful event in the 18-month period, the mean impact the event had on eating habits was 7.0 out of 10.0 for the total sample and white persons and 7.2 out of 10.0 for the black persons.

Results of the first linear model examining only race as a predictor of weight maintenance after controlling for age, gender, education, marital status, and income are presented in Table 4.4. Race was not a significant predictor of weight change, p = .55. In the multivariate

logistic model, race was also not found to significantly predict unsuccessful weight maintenance, $p = .71$, after adjusting for the effects of age, gender, education, marital status, and income. See Table 4.5.

Table 4.6 shows the results of the multivariate linear regression of ELF change, BHE change, and WEL change predicting weight change. ELF change and WEL change did not significantly predict weight change, $p = .16$ and $p = .51$, respectively; however, BHE change was found to be a significant predictor of weight change. A 10% increase in barriers to healthy eating was associated with a 0.77% increase in weight after adjusting for the effects of other independent variables in the model, $p < .01$. The top five barriers are presented in Table 4.7 with the percentage of participants for each barrier who selected *somewhat important* or *very important* problem for me. The top four barriers were the same for everyone. However, for the total sample, successful maintainers, and white participants, the fifth barrier was *I use food as a reward or treat for myself*, whereas for the unsuccessful maintainers and black participants, *Resisting tempting high fat/high calorie foods in my work setting is difficult* was the fifth top barrier. Over 60% of all groups had difficulty staying motivated to keep off the weight they had lost and controlling what they ate when very hungry. Fewer successful maintainers had difficulty finding time for planning appropriate meals (39.4%) compared to unsuccessful maintainers (52.0%).

In Table 4.8, the multivariate results of the logistic model including ELF change, BHE change, and WEL change are presented including the two outliers on BHE score. In this analysis, age, BHE change and the quadratic effect for BHE change were significant predictors of unsuccessful weight maintenance. However, in Table 4.9, after the influential outliers were removed, the quadratic effect for BHE change became non-significant, $p = .55$, and race became

significant, $p = .04$. In this model, for every one-year increase in age, individuals were 1.11 times more likely to be successful at weight maintenance, $p < .01$, holding all other independent variables constant. For every one-percent increase in BHE, the odds of being an unsuccessful weight maintainer are 1.044 higher (95% CI = 1.02-1.07), $p < .01$, if all other independent variables are held constant. Additionally in this model, black participants had 3.81 (95% CI = 1.04-14.06) times the odds of being unsuccessful at weight maintenance, $p = .04$, compared to white participants, holding other independent variables constant.

Percent change in social support was not found to be a significant predictor of weight change in the multivariate linear regression model ($b = -0.019$, $SE = 0.025$, $p = .45$) or of unsuccessful weight maintenance in the logistic model (OR = 0.99, 95% CI = 0.97-1.01, $p = .35$). Effect modification with racial group was not supported as the interaction of race with social support was not significant in either the linear ($b = -0.05$, $SE = 0.06$, $p = .42$) or logistic models (OR = 1.02, 95% CI = 0.97-1.06, $p = .47$).

Sixty-four percent ($n = 69$) of participants reported experiencing one or more stressful life events in the 18 months between PREFER and PREFER II. Eighty-nine stressful life events were reported that fell into three main categories: family or significant other-related, work-related, and personal. Family or significant other-related events included illness, death, and parenting, family, or relationship stress. The work-related category included any stressful events related to the person's employment, e.g. difficult boss, problems with co-workers, job loss. Personal stressful events included personal injury or illness, relocating, marriage, financial problems, and going to college. The greatest proportion of events related to one's family or a significant other, as seen in Figure 4.1. While most participants ($n = 48$) reported only one stressful event, 13 individuals experienced two events and eight individuals experienced three

events in the 18-month time frame. In the multiple linear and logistic regression models, how much the stressful event affected eating habits (on a scale of 0 [no effect] to 10 [most effect]) was predictive of weight change. Table 4.10 shows the results of the linear model, and the logistic findings are presented in Table 4.11. A one-unit increase in the effect of the stressful event on eating was associated with a 0.51% increase in weight in the linear model ($p = .04$) after adjusting for the effects of other covariates in the model. The odds of being an unsuccessful weight maintainer are 1.3 times higher for each unit increase in the effect of the stressful life event, $p = .02$, holding all other independent variables constant.

When examining stress in the total sample using the item *how often does stress influence how you eat*, the mean percentage of time participants reported that stress influenced how they ate was a little more than half the time (Table 4.3). There was not a significant prediction of weight change by this item in the multivariate linear regression model ($b = 0.021$, $SE = 0.020$, $p = .31$). This item was marginally associated with unsuccessful weight maintenance in the logistic model (OR = 1.01, 95% CI = 0.99-1.03, $p = .07$). The reported mean percentage of the time that participants used techniques to reduce stress was approximately 38% (Table 4.3). The item *how often do you use tricks to lower your stress level* was not a significant predictor of weight maintenance in either the multivariate linear model ($b = -0.03$, $SE = 0.02$, $p = .17$) or logistic model (OR = 0.99, 95% CI = 0.98-1.01, $p = .29$). Racial group was not a significant predictor in the linear or logistic models with the stress items ($ps > .45$) and the interaction terms of race with the stress items were not significant in either the linear or logistic models ($ps > .10$).

4.5 DISCUSSION

Weight maintenance in PREFER II at 18 months after a behavioral weight loss trial was moderate with participants regaining an average of 4.5% of their weight. The majority of individuals were successful at maintaining their weight with 58% of white participants and 54% of black participants regaining ≤ 5% from the completion of PREFER to PREFER II. Because a longer duration of successful maintenance has been associated with a greater chance of longer-term maintenance (Wing & Phelan, 2005), these successful participants might be able to look forward to continued success. The importance of weight maintenance over time must be viewed in the context of typical weight change as studies have found that untreated obese individuals may gain from 1 kg to 6.7 kg over the course of 5 years (Kumanyika, Obarzanek, Stevens, Hebert, & Whelton, 1991; Rothacker, 2000; Williamson, 1993). The proportion of individuals in PREFER II who regained ≤ 5% is similar to what others have found following behavioral weight loss treatment. Befort and colleagues followed 179 former weight loss participants an average of 14 months after they had completed behavioral treatment and found that 42% had regained < 5% of their end-of-treatment weight compared to 58% who gained ≥ 5% (2007). Others have reported that 78% of the sample gained < 5% of their weight 2.2 years after a behavioral program that promoted consumption of foods with a low-energy density (Greene et al., 2006). A study of weight loss maintenance after completion of a commercial weight loss program reported that 60.1% had maintained at least a 5% weight loss at 2 years (Lowe et al., 2001). Approximately 70% of individuals participating in a trial specifically targeting weight loss maintenance regained < 5% of lost weight at one year (Harvey-Berino, Pintauro, Buzzell et al., 2002). Thus, the number of individuals in PREFER II who were successful at maintaining their weight is comparable to previous studies.

Racial differences in weight maintenance were generally not noted in this sample. White persons regained about 4.5% of their weight while black individuals regained 5%. Race did not significantly predict weight maintenance with the exception of one logistic model where black participants were more likely to be classified as unsuccessful weight maintainers compared to their white counterparts. An explanation for this finding is not readily apparent, but a result of categorizing a continuous variable, as we have done for the percent weight change outcome, is a loss of information that typically reduces measurement precision (Zhao & Kolonel, 1992), which might have affected the significant findings for race in this one binary logistic model. Yet, the results of the same linear regression model are in the same direction, supporting the association of black participants and weight regain, but did not reach statistical significance at $p = .10$. Findings regarding racial minorities and weight maintenance after a loss are inconsistent in the literature. Two large clinical trials examining weight loss and maintenance as a method of blood pressure control found that black participants tended to lose less weight initially, but then tended to regain less weight at 36 months (Kumanyika et al., 2002; Stevens et al., 2001). For example, in the Trials of Hypertension Prevention— Phase II, white participants lost 2.3 kg more weight than black participants at 6 months, but the difference in weight loss between Blacks and Whites was only 0.5 kg at 36 months (Stevens et al., 2001). In the Trial of Nonpharmacologic Interventions in the Elderly, weight regain between 6 months and the end of the trial was greater in white participants compared to black participants in both treatment arms (Kumanyika et al., 2002). Rickel and colleagues found that black persons lost less weight during the 6-month weight loss phase, but experienced a weight regain similar to their white counterparts during the 12-month maintenance phase (Rickel et al., 2007). Others have reported greater weight regain among black diabetic participants after a weight loss program (Wing & Anglin, 1996). Our

results lend support to the findings that weight regain after a behavioral weight loss trial is similar for white and black persons.

Barriers to healthy eating significantly predicted weight regain and unsuccessful weight maintenance in PREFER II. Perceived barriers to weight management have been reported by others (Andajani-Sutjahjo et al., 2004; Atlantis, Barnes, & Ball, 2008; Befort et al., 2007). The percentage of unsuccessful weight maintainers frequently experiencing the barriers of *healthy eating being too expensive* and *healthy eating being too time consuming* was higher compared to successful maintainers (7.5% vs. 0% and 19.0% vs. 8.8%, respectively) in a follow-up study of a university-based behavioral weight loss program (Befort et al., 2007). In line with these results, finding time for appropriate meal planning was difficult for a greater proportion of the unsuccessful maintainers compared to the successful maintainers in our study. Befort and colleagues also found that a higher percentage of unsuccessful maintainers (88.1%) reported frequently experiencing the barrier of *too easy to slip back into old habits* compared to successful maintainers (52.9%) (2007). This barrier could be perceived as a lack of motivation for sustaining weight management behaviors. Similarly, we found that a majority of the participants had difficulty with motivation for keeping off the weight and for eating appropriately. Others have reported in survey studies that a lack of time (Kearney & McElhone, 1999; Lappalainen, Saba, Holm, Mykkanen, Gibney et al., 1997; Reinli, Will, Thompson-Reid, Liburd, & Anderson, 1996) and lack of motivation (Andajani-Sutjahjo et al., 2004) were barriers to eating a healthy diet. Low motivation has also been reported as more common among regainers than maintainers in follow-up assessments of weight maintenance (DePue et al., 1995). The price of healthy food items has been reported to be a barrier to healthy eating (Andajani-Sutjahjo et al., 2004; Befort et al., 2007; Lappalainen et al., 1997). Yet, only 17% of participants

in PREFER II reported that the cost of low-fat/low-calorie foods was a *somewhat* or *very important* problem, perhaps because over half of the participants were in the highest income category (≥ $50,000 annual household income).

Increasing age was protective against being an unsuccessful weight maintainer in one logistic regression model for PREFER II. This was not a consistent finding in other models, although age was included as a covariate in all the multivariate models. Yet, research findings support the association of weight loss maintenance with older age (Anderson, Vichitbandra, Qian, & Kryscio, 1999; Ogden, 2000), and the relationship of larger weight gain with younger age in a trial of weight gain prevention (Jeffery, McGuire, & French, 2002). The finding that increasing age was associated with successful maintenance could be a result of better adherence to behavior changes necessary for weight management. Older age has been associated with better medication adherence (Barclay, Hinkin, Castellon, Mason, Reinhard et al., 2007; Hinkin, Hardy, Mason, Castellon, Durvasula et al., 2004; O'Connell, Braitstein, Hogg, Yip, Craib et al., 2003; Sajatovic, Blow, Kales, Valenstein, Ganoczy et al., 2007), adherence to treatment for alcohol addiction (Oslin, Pettinati, & Volpicelli, 2002), as well as with better adherence to dietary and physical activity recommendations (Bautista-Castano, Molina-Cabrillana, Montoya-Alonso, & Serra-Majem, 2004), and higher attendance at weight loss treatment sessions (Clark, Niaura, King, & Pera, 1996).

The impact of a stressful event on eating habits significantly predicted weight regain in the subsample of participants who reported experiencing a stressful life event. Psychological stress results in a physiologic stimulation of the hypothalmic-pituitary-adrenal axis resulting in increases in glucocorticoids (including cortisol) and activation of the sympathetic nervous system, which causes an increase in blood pressure and heart rate (Black, 2006; Kyrou,

Chrousos, & Tsigos, 2006). Clinical evidence indicates that cortisol or additional glucocortocoids may be involved with higher levels of food intake (Bjorntorp, 2001), particularly appetizing, high-calorie "comfort" foods, in an effort to ameliorate the physiologic effects of stress (Dallman, Pecoraro, Akana, La Fleur, Gomez et al., 2003). Research suggests that individuals who are more physiologically responsive to stress are at higher risk of becoming obese and developing central adiposity (Bjorntorp, 2001; Brydon, Wright, O'Donnell, Zachary, Wardle et al., 2008). For example, abdominal obesity was associated with larger stress-related increases in diastolic blood pressure and total peripheral resistance in pre-menopausal women (Davis, Twamley, Hamilton, & Swan, 1999). Women who secreted more cortisol in response to stress ate more food between meals (Newman, O'Connor, & Conner, 2007) and more calorie-dense, sweet and high-fat foods (Epel, Lapidus, McEwen, & Brownell, 2001). Also, women with greater inflammatory cytokine responses to stress had greater central adiposity compared to those with lower cytokine stress responses (Brydon et al., 2008).

Stress has been linked to weight change in several studies (Brunner, Chandola, & Marmot, 2007; DePue et al., 1995; Sarlio-Lahteenkorva, Rissanen, & Kaprio, 2000; Steptoe & Wardle, 2005; Vgontzas, Lin, Papaliaga, Calhoun, Vela-Bueno et al., 2008); however, the change in weight is not always a gain. Individual responses to stress might also include decreased appetite and food intake (Dallman et al., 2003; Wardle & Gibson, 2002). While a long-term study in Finland found that men who regained weight reported higher stress levels than maintainers (Sarlio-Lahteenkorva et al., 2000), others have noted that the effect of work stress on weight was related to initial BMI. Individuals with high levels of work stress and a BMI < 22 kg/m^2 experienced weight loss at the 5-year assessment while stressed overweight and obese persons (BMI > 27 kg/m^2) gained weight (Kivimaki, Head, Ferrie, Shipley, Brunner et al.,

2006). In our study, a greater impact of a stressful event on eating habits was significantly related to weight gain among the 69 individuals who had experienced a stressful life event, but the percentage of time that stress influenced eating in the entire sample was not related to weight change. These findings could be because individuals who did not report a stressful event had lower levels of stress overall or perhaps had an individual physiologic response to stress that did not influence their eating behavior. The percentage of time that stress-reducing techniques were used was also not predictive of weight change, possibly because these techniques were used rather infrequently.

Some factors— self-efficacy, social support and low-fat diet experiences— were not associated with weight maintenance in this study despite being associated with weight management in previous studies (Elfhag & Rossner, 2005; Kayman et al., 1990; Wing & Jeffery, 1999; Wolfe, 2004). Yet, some have found that self-efficacy for weight management was not correlated with weight loss (Fontaine & Cheskin, 1997). In agreement with our findings, Linde et al. noted that while self-efficacy beliefs predicted weight loss during treatment, self-efficacy did not predict weight change during the post-treatment time frame (Linde et al., 2006). Self-efficacy for resisting eating, as measured by the WEL, changed modestly during PREFER II with a mean increase for the sample of 1.4%. Self-efficacy for exercise was unrelated to weight maintenance in our study perhaps because the SEE was originally developed for and tested in an older population (Resnick & Jenkins, 2000). Some items, e.g. how confident are you that you could exercise if the weather was bothering you or you felt pain when exercising, might not have been relevant to the PREFER II participants. SEE scores were also unremarkable with an average score of 5.4 on a scale of 0 to 10. The level of social support that participants reported in this study was relatively high at baseline (mean 26.5) and increased by only 4% at the follow-up

PREFER II assessment, which could account for the lack of a relationship between social support and weight change in this study. Additionally, a mean weight increase of 4.5% would not be expected to be associated with an increase in social support even though the increase was minimal. Regarding low-fat diet experiences, as measured by the ELF, participants had fairly positive experiences adhering to the low-fat diet at baseline of PREFER II and reported essentially no change in their experiences during the 18 months, which could account for the ELF scale being unrelated to weight maintenance in this study.

A few limitations to our study existed. Because this was a follow-up study of weight maintenance, the selection of participants was restricted to those who took part in the PREFER weight loss trial and the demographic characteristics of the participants were confined to that sample. Thus, the representation of black participants was somewhat limited and a sample of 26 black individuals (22% of the total sample) might not be considered large enough to draw conclusions about weight maintenance in this racial group. Larger studies with greater proportions of black participants are needed to confirm these findings. Over half of the black and white particpants in the sample had a higher mean household income and education level than that of the county and state. Therefore, these findings might be generalizable to individuals of a higher socioeconomic status. In particular, because health disparities are often associated with a lower socioeconomic level (Lantz et al., 1998; Sorlie, Backlund, & Keller, 1995), it would be important to examine weight maintenance in a sample that was more diverse in terms of education and income. Because only the WEL was previously tested for validity and reliability in an African American population, the cultural salience of the other measures is not known. However, these scales have been used in samples with multiple racial groups without any obvious or known difficulties. Additionally, our sample consisted of only 15 males and only 1

black male. This small proportion of men would suggest that our findings may be generalizable only to women and the representation of one black male definitely prohibits generalizability to black men. Typically, men are underrepresented in weight loss and maintenance studies (Phelan, Hill, Lang, Dibelllo, & Wing, 2003; Tate, Jackvony, & Wing, 2003; Wing et al., 2006). Yet, some research suggests there may be differences in weight management between genders (Richelsen et al., 2007; Sarlio-Lahteenkorva et al., 2000). Recent findings revealed a significant increase in the prevalence of obesity among men (Ogden, Carroll, Curtin, McDowell, Tabak et al., 2006), reinforcing the need to examine weight maintenance in a larger sample of men.

The strengths of our study include a long-term follow-up assessment, an examination of weight maintenance among black individuals, an objective assessment of weight, and a high percentage of participants who completed the weight loss trial returned to participate in PREFER II. Maintenance of weight is not often examined for more than a year after a weight loss trial (Early et al., 2007; Fogelholm et al., 1999; Harvey-Berino, Pintauro, & Gold, 2002; LeCheminant et al., 2005). Thus, this study adds to the scant body of literature investigating long-term weight maintenance after weight loss treatment. Because of the financial and logistical constraints of assessing individuals' weights, weight maintenance studies frequently use self-reported weights (Befort et al., 2007; Lowe et al., 2001; McGuire, Wing, & Hill, 1999; Raynor et al., 2006). In our study, we weighted all but one participant using a calibrated digital scale, providing objective evidence of weight maintenance. Although previous investigations have found self-reported weights to be valid (Stunkard & Albaum, 1981), objective data assessment is more desirable. Our study also adds to the limited body of knowledge about weight maintenance in black individuals. Weight maintenance has rarely been studied in this population despite the fact that obesity is more prevalent among black persons (Ogden et al., 2006). Additionally, this

study provides support to the idea that maintenance of weight after a weight loss trial does not significantly differ for black persons compared to white persons and endorses the belief that strategies for maintaining weight need to be developed and disseminated to individuals of both racial groups. PREFER II had a very good return of participants after the weight loss trial with over 90% of individuals participating in this assessment of weight maintenance, and no differences existed between the few participants who returned and those who did not. The high participation rate of former PREFER participants reduces the likelihood that these findings are biased as a result of individuals who were less successful at weight maintenance not returning for the long-term study.

4.6 CONCLUSION

The results of this study indicate that a majority of the participants were able to maintain their weight 18 months after completing a behavioral weight loss program with a similar amount of weight change experienced by black and white participants. This study demonstrated that a focus on reducing barriers to weight management and healthy eating as well as coping with stressful life events is necessary to assist black and white persons with weight maintenance. Continued investigations need to determine the most appropriate strategies to help individuals reduce the negative impact of stress and overcome individual barriers they experience related to sustaining a their weight loss long-term.

Table 4.1: Items Included in the Social Support Composite Variable

ELF ***Please indicate the extent to which this factor has made it difficult for you to follow your eating plan:***	**Strongly Disagree** **1 2 3 4 5**	**Strongly Agree**
• Do you feel you are bothering your family members sometimes?		
• Do you find that family members complain about the low-fat diet?		
• Do you sometimes prepare separate meals for yourself and other family members?		
• Do you find that your spouse/family discourages you from staying on a low-fat diet?		
BHE ***Please indicate the extent to which this factor has made it difficult for you to follow appropriate eating habits:***	**Not at all a problem for me** **1 2 3 4 5**	**Very important problem for me**
• My family does not support my efforts to lose weight.		
• When I am with my family I find it difficult to watch what I eat.		
• My friends do not support me when I try to change my eating.		

Note. ELF= Experiences Associated with Following a Low-Fat Diet Scale; BHE= Barriers to Healthy Eating Scale. Responses selected on a five-point scale.

Table 4.2: Sociodemographic and Baseline Variables for PREFER II

	Total (***N*** **= 107)**	**White** (***n*** **= 81)**	**Black** (***n*** **= 26)**	**Difference between groups**	
Variable	***n (%)***	***n (%)***	***n (%)***	χ^2	***p***
Gender					
Female	92 (86.0)	67 (83.0)	25 (96.0)	0.05[c]	.11
Male	15 (14.0)	14 (17.0)	1 (4.0)		
Marital status[a]					
Married/living with partner	75 (70.8)	63 (79.0)	12 (46.0)	10.08	<.01
Not married/separated	31 (29.2)	17 (21.0)	14 (54.0)		
Employment[b]					
Full time	83 (79.1)	59 (74.7)	24 (92.4)		
Part time	10 (9.5)	9 (11.4)	1 (3.8)	3.13[c]	.21
Other	12 (11.4)	11 (13.9)	1 (3.8)		
Income[a]					
≤ $30,000/yr	16 (15.1)	12 (15.0)	4 (15.4)		
$30-50,000/yr	27 (25.2)	18 (22.5)	9 (34.6)	1.74[c]	.44
≥ $50,000/yr	63 (58.9)	50 (62.5)	13 (50.0)		
	Mean SD ***Median***	***Mean SD*** ***Median***	***Mean SD*** ***Median***	***U*** ***z***	***p***
Education (years)	15.3 2.6	15.4 2.5	14.69 2.7	856.5	.15
(Range: 12-23)	16.0	16.0	14.5	-1.45	
Age (years)	46.3 6.9	46.1 7.1	46.8 6.4	1006.0	.73
(Range: 20-55)	48.0	48.0	48.5	-0.34	

	Total (*N* = 107)		White (*n* = 81)		Black (*n* = 26)		Difference between groups	
Variable	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***U***	***p***
	Median		***Median***		***Median***		***z***	
BHE[b]	52.0	15.1	51.0	15.3	55.1	14.4	843.5	.17
(Range: 22-110)	54.0		53.0		60.0		-1.36	
ELF[d]	88.2	12.6	87.9	13.6	88.2	9.4	953.0	.65
(Range: 26-130)	87.0		87.0		89.5		-0.46	
WEL[b]	119.8	35.3	120.8	35.9	116.6	34.1	939.5	.52
(Range: 0-180)	113.0		119.0		108.0		-0.65	
Social support[d]	26.5	6.3	26.4	6.5	26.9	5.6	1017.5	.94
(Range: 7-35)	28.0		28.0		27.5		-0.02	
	Mean	***SD***	***Mean***	***SD***	***Mean***	***SD***	***t***	***p***
	Median		***Median***		***Median***			
Weight (lbs)	193.9	33.3	191.7	33.5	200.7	32.4	-1.20	.23
(Range: 126.7-264.4)	192.9		192.0		199.1			

Note. ELF= Experiences Associated with Following a Low-Fat Diet Scale; BHE= Barriers to Healthy Eating Scale; WEL= Weight Efficacy Lifestyle Scale; SD= Standard deviation; U= Mann Whitney U; t= t-value p= p-value; z= z-value. [a]One white participant had missing data. [b]Two white participants had missing data. [c]Fisher's exact test. [d]Three white participants had missing data.

Table 4.3: PREFER II Study Variables for the Total Sample, Black and White Participants

	Total (*N* = 107)		**White (*n* = 81)**		**Black (*n* = 26)**		**Difference between groups**	
Variable	***n (%)***		***n (%)***		***n (%)***		χ^2	***p***
Successful maintenance								
(≤ 5% weight regain)	61 (57.0)		47 (58.0)		14 (53.8)			
Unsuccessful maintenance							0.14	.71
(>5% weight regain)	46 (43.0)		34 (42.0)		12 (46.2)			
	Mean	***SD***	***Mean***	***SD***	***Mean***	***SD***		
	Median		***Median***		***Median***		***t***	***p***
% Weight change	4.6	5.8	4.4	5.6	5.0	6.6	-0.45	.65
(Range: -14.81-27.02)	4.2		4.2		4.2			
% ELF change[a]	.65	11.5	-.37	10.9	3.72	12.8	-1.58	.12
(Range: -28.4-37.7)	0		-1.59		5.34			
SEE[b]	5.4	2.5	5.4	2.6	5.3	2.5	0.14	.89
(Range: 0-10)	5.7		5.8		4.7			
	Mean	***SD***	***Mean***	***SD***	***Mean***	***SD***	***U***	***p***
	Median		***Median***		***Median***		***z***	
% BHE change[c]	12.7	30.5	13.1	29.7	11.5	33.5	1003.0	.86
(Range: -55.7-125.8)	8.5		8.5		7.6		-0.18	
% WEL change[c]	1.4	42.8	.62	44.5	3.6	38.1	938.0	.51
(Range: -56.2-261.9)	-5.0		-6.3		-2.7		-0.66	
% Social support change[a]	3.9	23.9	4.7	24.7	1.6	21.8	956.0	.66
(Range: -44.0-100.0)	0		0		0		-0.44	

	Total (N = 107)		White (n = 81)		Black (n = 26)		Difference between groups	
Variable	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***U***	***p***
	Median		***Median***		***Median***		***z***	
How often *(% of time)* does stress influence how you eat?[b,d]	56.8	30.7	57.9	28.9	53.5	36.0	970.5	.61
	50.0		70.0		60.0		-0.51	
(Range: 0-100)								
How often *(% of time)* did you use tricks to lower your stress level?[b,d]	38.7	28.5	38.9	27.7	38.1	31.2	1004.5	.79
	35.0		35.0		35.0		-0.26	
(Range: 0-100)								
How much did this stressful event affect your eating habits?[b,e]	7.0	3.1	7.0	2.9	7.2	3.5	433.5	.45
	8.0		8.0		8.5		-0.76	
(Range: 0-10)								

Note. ELF= Experiences Associated with Following a Low-Fat Diet Scale; SEE= Self-Efficacy for Exercise Scale; BHE= Barriers to Healthy Eating Scale; WEL= Weight Efficacy Lifestyle Scale; SD= Standard deviation; U= Mann Whitney U; t= t-value p= p-value; z= z-value. [a]Three white participants had missing baseline data. [b]Only measured in PREFER II; therefore, no percent change score presented. [c]Two white participants had missing baseline data. [d]One white participant had missing data. [e]Subsample analysis of n=69 with White n=49, Black n=20.

Table 4.4: Multivariate Linear Regression of Race Predicting % Weight Change (N=106, White n=80, Black n=26)

Variable	*b*	*SE (b)*	*Standardized Beta*	*t-value*	*p-value*
Age	-0.06	0.09	-.08	-0.73	.47
Gender[a]	-2.50	1.83	-.15	-1.37	.17
Marital status[b]	1.62	1.43	.13	1.13	.26
Education	0.16	0.25	.07	0.66	.51
Income[c]					
≤ $30,000/yr	-1.20	1.86	-.07	-0.64	.52
$30-50,000/yr	0.81	1.46	.06	0.55	.58
Race[d,e]					
(Black/White)	0.86	1.45	.06	0.60	.55

Note. One participant was excluded from the model due to missing data on marital status and income. [a]Female coded as 0 an treated as the reference . [b]Not married/separated coded as 0 and treated as the reference. [c]Compared to the reference group, ≥ 50,000. [d]White participants coded as 0 and treated as the reference. [e]The unadjusted effect for race was non-significant, $b = 0.59$, $SE = 1.31$, $p = .65$.

Table 4.5: Multivariate Logistic Regression of Race Predicting Unsuccessful Weight Maintenance (N=106, White n=80, Black, n=26)

Variable	*b*	*SE (b)*	*Wald*	*df*	*p-value*	*Odds Ratio (OR)*	*95% CI for OR*
Age	-0.05	0.03	2.07	1	.15	.95	.89-1.02
Gender[a]	-0.93	0.68	1.85	1	.17	.39	.10-1.51
Marital status[b]	0.58	0.52	1.24	1	.26	1.79	.64-4.98
Education	0.04	0.09	0.16	1	.69	1.04	.87-1.24
Income[c]							
≤ $30,000/yr	-0.57	0.67	0.73	1	.39	.56	.15-2.08
$30-50,000/yr	-0.25	0.51	0.23	1	.63	.78	.29-2.14
Race[d,e]							
(Black/White)	0.32	0.51	0.39	1	.53	1.38	.51-3.77

Note. Unsuccessful weight maintenance defined as > 5% regain. One participant was excluded from the model due to missing data on marital status and income. [a]Female coded as 0 an treated as the reference. [b]Not married/separated coded as 0 and treated as the reference. [c]Compared to the reference group, ≥ 50,000. [d]White participants coded as 0 and treated as the reference. [e]The unadjusted effect for race was non-significant, Odds Ratio = 1.18, 95% Confidence Interval = 0.49-2.88, p = .71.

Table 4.6: Multivariate Linear Analysis with ELF Change, BHE Change, and WEL Change Predicting % Weight Change (N=101, White n=76, Black n=25)

Variable	*b*	*SE (b)*	*Standardized Beta*	*t-value*	*p-value*
Age	-0.13	0.08	-.15	-1.50	.13
Gender[a]	-0.57	1.84	-.03	-0.31	.75
Marital status[b]	2.35	1.41	.18	1.67	.09
Education	0.04	0.25	.02	0.16	.87
Income[c]					
≤ $30,000/yr	-0.65	1.86	-.04	-0.35	.72
$30-50,000/yr	0.46	1.38	.03	0.33	.73
% ELF change	-0.07	0.05	-.15	-1.42	.15
% BHE change	0.08	0.02	.35	3.21	<.01
% WEL change	-0.01	0.02	-.07	-0.66	.51
Race[d]					
(Black/White)	2.33	1.41	.17	1.65	.10

Note. Three participants excluded from the model due to missing data on marital status and income or questionnaires at baseline. Three participants who were influential outliers excluded from the model. BHE= Barriers to Healthy Eating Scale; WEL= Weight Efficacy Lifestyle Scale; ELF= Experiences Associated with Following a Low-Fat Diet Scale. [a]Female coded as 0 and treated as the reference. [b]Not married/separated coded as 0 and treated as the reference. [c]Compared to the reference group, ≥ $50,000. [d]White participants coded as 0 and treated as the reference.

Table 4.7: Top Five Barriers to Healthy Eating: % of Participants who Selected "Somewhat" or "Very" Important Problem for me

Barrier	*Total Sample (N = 107)*	*Successful (n = 61)*	*Unsuccessful (n = 46)*	*White (n = 81)*	*Black (n = 26)*
1. Losing weight is rewarding, but I have trouble staying motivated to keep off the weight I lost.	65.6%	65.2%	66.0%	66.7%	69.2%
2. When I am very hungry, I have trouble controlling what I eat.	63.8%	60.6%	68.0%	65.4%	69.2%
3. It is difficult to motivate myself to eat appropriately.	49.1%	51.2%	46.0%	50.6%	57.7%
4. It is difficult to find time to plan appropriate meals for myself.	44.8%	39.4%	52.0%	44.5%	50.0%
5. I use food as a reward or treat for myself.	44.8%	41.0%	[a]	49.4%	[a]
5. Resisting tempting high fat/high calorie foods in my work setting is difficult.	[b]	[b]	50.0%	[b]	50.0%

[a]The fifth barrier for the unsuccessful and black groups was *Resisting tempting high fat/high calorie foods in my work setting is difficult*. [b]The fifth barrier for the total sample, successful, and white groups was *I use food as a reward or treat for myself*.

Table 4.8: Multivariate Logistic Regression with the Linear and the Quadratic Effect for BHE Change, ELF Change and WEL Change Predicting Unsuccessful Weight Maintenance with Two Outlying Values (N=103, White n=77, Black n=26)

Variable	*b*	*SE (b)*	*Wald*	*df*	*p-value*	*Odds Ratio (OR)*	*95% CI for OR*
Age	-0.09	0.04	5.42	1	.02	0.91	.85-.99
Gender[a]	-0.56	0.79	0.50	1	.47	0.57	.12-2.71
Marital status[b]	0.94	0.64	2.18	1	.14	2.56	.73-8.91
Education	0.01	0.10	<0.01	1	.92	1.01	.83-1.23
Income[c]							
≤ $30,000/yr	-0.66	0.80	0.69	1	.40	0.51	.11-2.47
$30-50,000/yr	-0.72	0.62	1.35	1	.24	0.49	.15-1.63
% ELF change	-0.05	0.02	3.66	1	.05	0.95	.91-1.001
% BHE change	0.04	0.01	8.57	1	<.01	1.04	1.01-1.07
% WEL change	<0.01	<0.01	0.09	1	.76	1.00	.99-1.02
Quadratic effect for % BHE change	<0.01	<0.01	7.24	1	<.01	~1.00	.9991-.9998
Race[d]							
(Black/White)	1.03	0.62	2.76	1	.09	2.80	.83-9.46

Note. Unsuccessful weight maintenance defined as > 5% regain. Three participants excluded from the model due to missing data on marital status and income or questionnaires at baseline. One participant excluded from the model who was an influential outlier on WEL change. BHE= Barriers to Healthy Eating Scale; WEL= Weight Efficacy Lifestyle Scale; ELF= Experiences Associated with Following a Low-Fat Diet Scale. [a]Female coded as 0 and treated as the reference. [b]Not married/separate coded as 0 and treated as the reference. [c]Compared to the reference group, ≥ $50,000. [d]White participants coded as 0 and treated as the reference.

Table 4.9: Multivariate Logistic Regression with the Linear and the Quadratic Effect for BHE Change, ELF Change, and WEL Change Predicting Unsuccessful Weight Maintenance Without Two Outlying Values (N=101, White n=76, Black n=25)

Variable	*b*	*SE (b)*	*Wald*	*df*	*p-value*	*Odds Ratio (OR)*	*95% CI for OR*
Age	-0.10	0.040	7.10	1	<.01	0.90	0.83-.97
Gender[a]	-0.32	0.862	0.14	1	.70	0.72	0.13-3.91
Marital status[b]	1.26	0.678	3.47	1	.06	3.53	0.94-13.34
Education	0.03	0.104	0.11	1	.74	0.97	0.79-1.18
Income[c]							
≤ $30,000/yr	-0.68	0.807	0.70	1	.40	0.51	0.10-2.47
$30-50,000/yr	-0.81	0.625	1.69	1	.19	0.44	0.13-1.51
% ELF change	-0.04	0.024	2.94	1	.08	0.96	0.91-1.00
% BHE change	0.04	0.014	9.60	1	<.01	1.04	1.02-1.07
% WEL change	<0.01	<0.01	0.14	1	.71	1.00	0.99-1.02
Quadratic effect for % BHE change	<0.01	<0.01	0.38	1	.53	1.00	0.99-1.00
Race[d]							
(Black/White)	1.34	.66	4.05	1	.04	3.81	1.04-14.06

Note. Unsuccessful weight maintenance defined as > 5% regain. Three participants excluded from the model due to missing data on marital status and income or baseline questionnaires. Three participants excluded from the model who were influential outliers (one on WEL change, two on BHE change). BHE= Barriers to Healthy Eating Scale; WEL= Weight Efficacy Lifestyle Scale; ELF= Experiences Associated with Following a Low-Fat Diet Scale. [a]Female coded as 0 and treated as reference. [b]Not married/separated coded as 0 and treated as reference. [c]Compared to the reference group, ≥ $50,000. [d]Whites coded as 0 and treated as the reference.

Table 4.10: Multivariate Linear Regression of % Weight Change Predicted by how Stressful Event Affected Eating on a Scale of 0 (No Effect) to 10 (Most Effect), (n=68, White n=48, Black n=20)

Variable	*b*	*SE (b)*	*Standardized Beta*	*t-value*	*p-value*
Age	-0.03	0.10	-.04	-0.34	.73
Gender[a]	-2.73	2.33	-.16	-1.17	.24
Marital status[b]	3.13	1.80	.25	1.73	.08
Education	0.29	0.32	.13	0.91	.36
Income[c]					
≤ $30,000/yr	-0.23	2.17	-.01	-0.11	.91
$30-50,000/yr	2.41	1.93	.17	1.25	.21
Effect of stressful life event on eating (0-10)	0.51	0.24	.26	2.11	.04
Race[d] (Black/White)	-1.02	1.82	-.08	-0.56	.57

Note. Model includes only the subsample of participants who reported experiencing a stressful event. [a]Female coded as 0 and treated as the reference. [b]Not married/separated coded as 0 and treated as the reference. [c]Compared to the reference group, ≥ $50,000. [d]White participants coded as 0 and treated as the reference.

Table 4.11: Multivariate Logistic Regression of Unsuccessful Weight Maintenance Predicted by how the Stressful Event Affected Eating on a Scale of 0 (No Effect) to 10 (Most Effect), (n=68, White n=48, Black n=20)

Variable	*b*	*SE (b)*	*Wald*	*df*	*p-value*	*Odds Ratio (OR)*	*95% CI for OR*
Age	-0.03	0.04	0.43	1	.51	0.97	0.90-1.05
Gender[a]	-0.82	0.90	0.83	1	.36	0.44	0.07-2.56
Marital status[b]	0.83	0.70	1.42	1	.23	2.31	0.58-9.09
Education	0.13	0.12	1.31	1	.25	1.14	0.91-1.44
Income[c]							
≤ $30,000/yr	-0.57	0.83	0.47	1	.49	0.57	0.11-2.87
$30-50,000/yr	0.17	0.72	0.05	1	.81	1.18	0.29-4.86
Effect of stressful life event on eating (0-10)	0.26	0.11	5.37	1	.02	1.30	1.04-1.63
Race[d] (Black/White)	-0.42	0.66	0.39	1	.53	0.66	0.18-2.42

Note. Unsuccessful weight maintenance defined as > 5% regain. Model includes only the subsample of participants who reported experiencing a stressful event. [a]Female coded as 0 and treated as the reference. [b]Not married/separated coded as 0 and treated as the reference. [c]Compared to the reference group, ≥ $50,000. [d]White participants coded as 0 and treated as the reference.

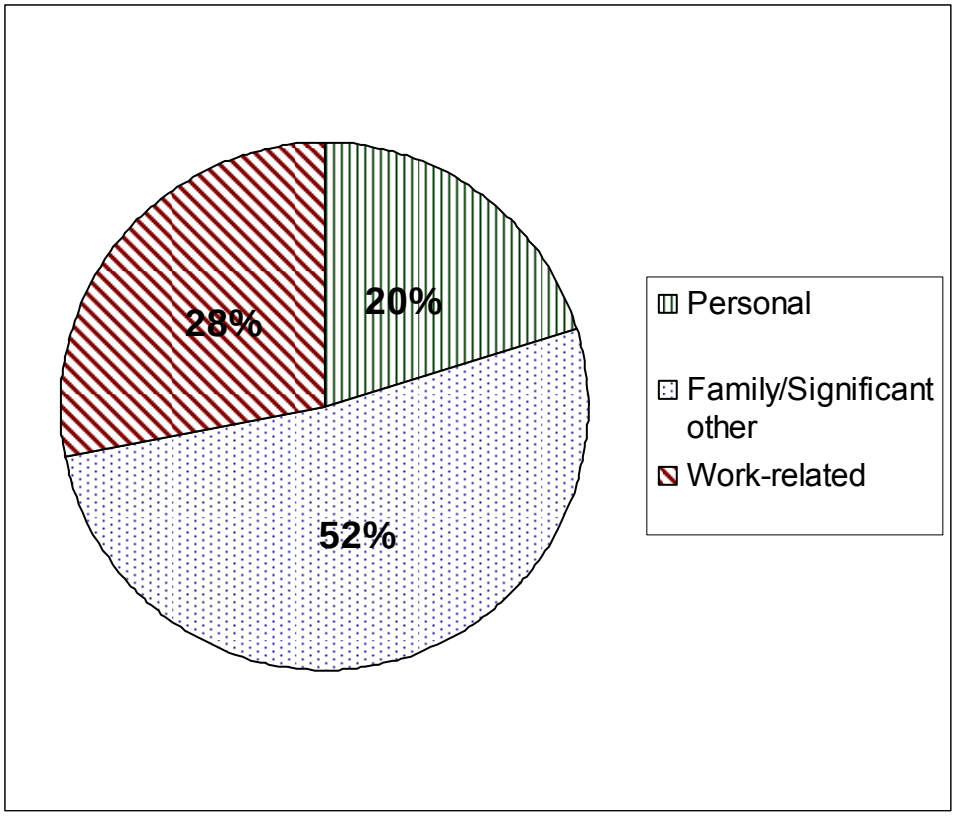

Figure 4.1: Stressful Life Event Categories

5.0 RESULTS MANUSCRIPT #2

Use of Behavioral Strategies for Weight Maintenance 18 Months After a Behavioral Weight Loss Trial

5.1 ABSTRACT

Objective: To examine the behavioral strategies used by participants for weight maintenance after a behavioral weight loss trial and investigate whether or not differences in strategy use existed between black and white participants as well as between successful and unsuccessful weight maintainers. **Methods**: We conducted an ancillary study, PREFER II, 18 months after the completion of a behavioral weight loss trial, PREFER. Participants self-identified their race as Black or White. We weighed participants wearing light clothing and no shoes using the Tanita digital scale and asked about the percentage of time in the previous 18 months individuals used 16 strategies they learned during PREFER. Successful weight maintenance was defined as ≤ 5% weight regain. **Results**: The sample (N = 107, n = 81 White, n = 26 Black) was predominantly female (86.0%), middle-aged (M = 46.3, SD = 6.9 years old), and successful at weight maintenance. Only 25% of the 16 behavioral strategies were used more than half the time. Reading food labels while grocery shopping was the most commonly used strategy for all participants. Two differences in strategy use were found between the black and white

participants; black participants used recipe modification and portion-control methods less often than white participants, *p*s < .04. There were no differences in strategy use between the successful and unsuccessful participants. **Conclusions**: Individuals who participated in a behavioral weight loss trial did not use most weight-control strategies they had learned for the majority of time in the 18 months after the trial. Some differences between racial groups suggest the incorporation of culturally-tailored strategies in weight management programs to support the weight-maintenance efforts of black individuals.

5.2 INTRODUCTION

Obesity and overweight are global problems that affect the health of millions of individuals in the United States and worldwide (Roth et al., 2004). Additionally, black persons are affected in greater proportions by obesity and its concomitant health conditions (Must et al., 1999; Ogden et al., 2006). One of the utmost challenges in the area of obesity treatment is the dilemma of weight regain after loss (Jeffery et al., 2000). Modifications of eating and physical activity lifestyle behaviors remain the features of effective weight loss treatment, but are difficult to implement long-term (Cummings, Parham, Strain, & American Dietetic Association, 2002). Little is known about the strategies individuals continue to use after behavioral weight loss treatment to promote weight maintenance, or if differences exist between racial minority groups in their use of weight maintenance strategies.

Empirical evidence from The National Weight Control Registry, a registry of individuals who have been able to lose at least 13.6 kg and maintain the loss for a minimum of 1 year (Klem et al., 1997), supports the use of several behavioral strategies for successful weight maintenance,

e.g. increased physical activity, eating a low-fat diet, regularly self-monitoring food intake and body weight (Wing & Hill, 2001), restricting one's assortment of foods (Raynor et al., 2005), following a consistent weekly meal plan (Gorin et al., 2004) and eating breakfast (Wyatt et al., 2002). However, this registry has nearly all white participants (Wing & Phelan, 2005). Scant research has examined weight management strategies among black persons, but some findings suggest there may be differences in weight-control techniques used by black individuals. Tyler and colleagues found that African American women used more commercial diet tools and took part in weight loss behaviors for less time than white women who weighed less; African American women in this study reported discontinuing weight loss activities due to boredom, difficulty eating bland food, and lack of family support (Tyler, Allan, & Alcozer, 1997). Less time spent participating in weight loss behaviors may signify a problem for successful long-term weight maintenance. Cultural differences in food and eating preferences exist for some members of racial groups (Kumanyika, Morssink, & Agurs, 1992), such as food practices that are handed down from generation to generation or deep frying as a means of food preparation (Airhihenbuwa et al., 1996), and could add an additional barrier to efforts to sustain behavioral strategies for weight maintenance.

Successful weight maintenance seems to require ongoing adherence to the behavioral lifestyle changes from which the initial weight loss resulted (Perri & Foreyt, 2004). Therefore, the purpose of this investigation, PREFER II, was to examine the use of behavioral strategies for long-term weight maintenance 18 months after a behavioral weight loss trial to assess how frequently participants practiced strategies learned during the trial. We also explored whether or not differences existed in the use of behavioral weight-management strategies between black and

white participants as well as between successful weight maintainers and unsuccessful weight maintainers.

5.3 METHODS

PREFER II was a descriptive, ancillary study conducted 18 months after the completion of PREFER, a randomized clinical trial of behavioral weight loss treatment. Recruitment for PREFER took place in three cohorts and participants were randomly assigned first to receive their preferred dietary treatment or not (Preference-Yes or Preference-No) and secondly to a standard reduced-calorie and fat diet or a lacto-ovo-vegetarian reduced-calorie and fat diet. The PREFER intervention used standard behavioral therapy (SBT) for weight loss, an established method that integrates instruction and counseling in modifying lifestyle behaviors, adjusting food intake to reduce calories and fat, and increasing physical activity (Wadden et al., 2004; Wing, 2004). Features of SBT include providing nutritional information, designating goals for daily dietary intake and weekly physical activity, presenting planned lessons to groups of 10-20 participants and facilitating group discussion. Participants also self-monitor food intake and physical activity, receive written interventionist feedback, and apply various behavioral change strategies shown to be effective, e.g. modifying one's environment, problem-solving, altering 'all or nothing' thinking and preventing relapse (Stunkard & Berthold, 1985; Wadden & Butryn, 2003; Wing, 1998). PREFER participants attended weekly group meetings during months 1-6, biweekly meetings in months 7-9 and monthly meetings during months 10-12. In the final 6-month maintenance phase of the trial, there were no group sessions and participants were not in contact with study personnel except to set up an end-of-study assessment appointment.

Further information about the design and findings of the PREFER trial have been published elsewhere (Burke, Choo et al., 2006; Burke et al., 2007; Burke, Styn et al., 2006; Burke, Warziski et al., 2008). Overall, the mean weight loss at trial end was between 4% and 8% for the four randomized groups with no significant difference in weight loss for persons in the lacto-ovo-vegetarian diet groups compared to the standard diet groups; individuals randomly assigned to Preference-No lost more weight than those who were randomized to Preference-Yes (Burke, Warziski et al., 2008).

For PREFER II, we mailed letters to participants asking them to return for a follow-up study 18 months after the PREFER trial ended. If participants did not respond by two weeks after the letter was sent, we called individuals on the phone to request that they return for one additional assessment. PREFER personnel had not informed participants during the trial that any follow-up study would occur, and there was no contact with participants after PREFER until the letter was sent asking for their participation in PREFER II. We collected information on current weight and behavioral strategies utilized for weight maintenance at the Clinical Translational Research Center or the School of Nursing at the University of Pittsburgh or another participant-selected convenient location, e.g., their workplace or home.

The eligibility criteria of the PREFER trial determined the inclusion and exclusion criteria of PREFER II. Participants were 18-55 years old when they were enrolled in PREFER, agreed to be randomized to receive their preferred treatment or not and one of the two dietary plans, had a BMI between 27 and 43 kg/m^2 inclusively, and had completed a 5-day food diary demonstrating they could self-monitor their eating. Exclusion criteria consisted of a medical diagnosis that required physician management of the diet or physical activity (e.g. diabetes, recent myocardial infarction), physical limitations affecting the ability to exercise, pregnancy or

planning a pregnancy during the trial, treatment for a psychological illness, reported daily consumption of four or more alcoholic drinks, current weight loss medication use or current/recent (within the past 6 months) enrollment in a weight loss program, or no regular consumption of meat, fish or poultry. The PREFER final assessment time point was the baseline of PREFER II; therefore, participants needed to have completed this visit to be eligible for PREFER II. Of the 132 PREFER participants from three cohorts who completed the weight loss trial, 119 took part in PREFER II between February 2006 and April 2007. Of the 119 who returned, two women were pregnant and one individual revealed that she had developed a binge eating disorder. Persons whose score on the Binge Eating Scale was > 37, suggesting they may have disordered eating behaviors (Gormally et al., 1982), were excluded from PREFER. Thus, these three individuals were excluded from PREFER II because they were not representative of the population from which the sample was to be drawn. In addition, nine participants self-selected a race other than Black or African American or White (three Hispanic, three Asian, one Native Hawaiian or other Pacific Islander, one Alaska Native and one American Indian) and were not included in the analysis. Hence, the total sample consisted of 107 individuals, 81 white participants and 26 black participants.

5.3.1 Measures

We used the Tanita Digital Scale to measure weight in pounds with participants in light clothing and no shoes. For one out-of-state participant, we obtained a self-reported current weight, as prior studies have documented the validity of self-reported weights (Kuczmarski et al., 2001; Spencer et al., 2002). A 2-kg correction was added to this weight to account for potential under-

reporting, as has been done previously (Kramer et al., 1986; Linde, Jeffery et al., 2004; Palta et al., 1982).

We developed a survey for PREFER II in order to assess the amount of time since the completion of PREFER that participants utilized various behavioral strategies for weight maintenance. The survey asked the participant to select what percent of the time in the previous 18 months, on a scale of 0-100%, he/she used 16 different behavioral strategies that were a part of the PREFER trial's intervention sessions. Using four additional items, we asked about stressful life events and the relationship of stress to eating; these findings were reported previously (See Results Manuscript 1). This survey was pilot tested prior to administration in PREFER II with a group of women being counseled for weight loss who reported that it was easy to understand and complete. Excellent internal consistency for the survey was found with Cronbach's alpha = .93.

We inquired about the use of several behavioral strategies in the survey. During the PREFER trial, participants learned how to self-monitor their food intake and physical activity each day in a paper diary, including the calories and fat grams of everything eaten as well as the total minutes and type of physical activity performed. The purpose of self-monitoring was to increase the participant's awareness of eating and activity behaviors in order to encourage behavior change. The effects of self-monitoring on weight management have been well documented (Baker & Kirschenbaum, 1993; Boutelle, Kirschenbaum, Baker, & Mitchell, 1999; Burke, Sereika, Music, Warziski, Styn et al., 2008; Wadden, Berkowitz, Womble, Sarwer, Phelan et al., 2005). Increasing daily lifestyle activity to enhance caloric expenditure was promoted, and participants learned ways to fit more activity into the day e.g., take the stairs instead of elevators, park the car farther away from the entrance, exit the bus one stop earlier and

walk the rest of the distance. Interventionists instructed participants to schedule time during the day for regular exercise, i.e. any aerobic exercise activity that increased the heart rate for at least 10 minutes, like brisk walking, bicycling or aerobics, and to increase their minutes of exercise to at least 150 minutes per week. Using positive reminders for participating in physical activity was also taught to participants, e.g. keeping gym shoes or bag in sight, making routine plans to exercise with a friend.

Participants learned about portion sizes and portion control as a means of reducing and managing caloric intake. They were given a reference card for determining the size of food items, e.g. one cup of cereal flakes is approximately the size of one's fist or three ounces of meat, fish or poultry is the size of a deck of cards. Another technique participants learned was how to read food labels paying particular attention to calorie and fat gram content for each serving, noting that packages may contain more than one serving per package. How to modify recipes so that the prepared food is lower in calories and fat grams was a part of the group sessions. Participants also learned to identify ingredients that may be high in fat or sugar and consider eliminating the ingredient, decreasing the amount or substituting a lower calorie or lower fat ingredient.

Knowing that one's environment can contribute significantly to weight management, interventionists taught participants to handle cues in their surroundings that may promote unhealthy eating or activity behaviors, e.g. keeping high-fat or high-calorie foods out of one's home and workplace or limiting television and computer time. Learning how to be assertive with others regarding following a healthy eating and activity plan was a part of the PREFER intervention, i.e. informing others in an honest, straightforward manner that one is committed to eating low-fat meals and exercising. The five steps of problem-solving— identify the problem,

brainstorm options for action, choose an action, make a plan to enact the action, take action and evaluate the results (D'Zurilla & Goldfried, 1971)— were part of the PREFER intervention sessions to help individuals successfully navigate challenging situations, e.g. how to manage eating at a social event or restaurant. How to eliminate negative thoughts, e.g. 'all-or-nothing' thinking about weight control or pessimism and excuse-making, was a component of the intervention. Participants learned how to confront negative thoughts and replace them with more positive, balanced thoughts like "I am not either on or off my diet; I am following a healthy eating lifestyle." Participants were taught how to develop and utilize social support, including informational, practical and emotional support, during the PREFER trial and learned specific ways to encourage others to be supportive of weight control efforts, e.g. don't offer second helpings of food, take part in physical activity together. As part of the PREFER trial's component on weight maintenance, participants learned the importance of monitoring their weight and weighing themselves at least once a week in order to allow them to take preventive actions against weight gain. If participants gained more than two pounds, they were to enact the 'restart plan' they had established for themselves, e.g. recording food intake and activity again, making exercise a priority, continuing to weight oneself, choosing low-fat, healthy foods.

5.3.2 Statistical analysis

Descriptive statistics were calculated for the percentage of the time over the 18-month period that each behavioral strategy was used. We stratified the total sample (by Blacks, Whites, successful participants, unsuccessful participants as well as successful and unsuccessful within each racial group) and presented descriptive statistics (means, standard deviations) for each strategy. In order to investigate if there were differences in behavioral strategy use between

successful and unsuccessful weight maintainers, we examined weight data from the final PREFER assessment (considered the baseline assessment for PREFER II) and the 18-month follow-up, PREFER II. We calculated a percent change score for weight as:

$$\frac{\textit{PREFER II weight - PREFER trial completion weight}}{\textit{PREFER trial completion weight}} \times 100 = \%\,\Delta \textit{ weight (weight change)}$$

We dichotomized this variable to derive two groups: successful weight maintainers (≤ 5% weight regain) and unsuccessful weight maintainers (> 5% weight regain). To test for differences in the use of each strategy between black and white participants, successful and unsuccessful participants, and successful and unsuccessful participants within and between each racial group, *t*-tests were used for normally distributed variables and the nonparametric Mann-Whitney U was used for non-normally distributed variables. We examined sociodemographic variables and baseline weight for differences between black and white participants as well as between those who returned for PREFER II and those who did not return using chi-square tests of independence, Fisher's exact tests, *t*-tests or Mann Whitney U tests as appropriate. We set the significance level for two-sided hypothesis testing at .05 and used SPSS (version 15.0, SPSS Inc., Chicago, IL 2006) for the analysis.

5.4 RESULTS

Sociodemographic and baseline characteristics of the PREFER II sample are found in Table 5.1. Most participants were female (86%), employed full time (79.1%) and middle-aged (*M* = 46.3 years, *SD* = 6.9 years). With the exception of marital status, black and white participants did not significantly differ on sociodemographic variables. There was also no difference in baseline

weight between racial groups, *p*s > .17. Sixty-one participants (57%) were successful weight maintainers and 46 (43%) were unsuccessful. In comparing the successful and unsuccessful weight maintainers, those who successfully maintained their weight weighed significantly more at baseline than those who did not (M = 201.2 lbs, SD = 30.8 lbs vs. M = 184.2 lbs, SD = 34.2 lbs, respectively, $t_{(105)} = 2.69$, $p = .008$). Individuals who did not return for PREFER II were not significantly different in sociodemographic variables (age, gender, race/ethnicity, education, income, marital status) or baseline weight compared to those who participated in PREFER II, *p*s > .08, supporting the generalizability of these findings to the entire PREFER sample. There were also no differences in the above variables between the nine individuals who self-selected a race other than Black or White and those included in the analysis, *p*s > .15.

The 16 strategies for the total sample, black, white, successful and unsuccessful participants are listed in Table 5.2 ordered from the highest mean percentage of the time to the lowest mean percentage of the time strategies were used by the total sample. Notably, approximately three-quarters of the behavioral strategies learned during PREFER, about which we inquired, were used less than half the time during the 18-month follow-up period. In fact, white, successful, and unsuccessful participants used only four strategies for more than a mean of 50% of the time, while black participants used three strategies for over half the time. The behavioral strategy used for the highest mean percentage of the time by the total sample as well as all the groups was *reading food labels while grocery shopping, looking at total calories, fat grams, and healthy claims ('reduced fat, low-cal, light').* The mean percentage of the time this strategy was used was over 61% for all groups (see Table 5.2), and 58% of the total sample reported reading food labels 70% of the time or more. *Feeling you had the support of family and friends for sticking to your healthy eating plan and physical activity lifestyle* had the second

highest percentage of the time reported for the total sample, black, and successful participants, while it ranked third for white and fourth for unsuccessful participants. The strategy that was used for the third highest mean percentage of the time in the total sample and the successful participants was *modifying your recipes when making foods (reducing or substituting high-fat or high-calorie ingredients with healthier choices)*. This strategy was second for white participants, third for unsuccessful participants and fifth for black participants. Ranking in either the fourth or the fifth highest mean percentage of the time for all groups except the unsuccessful participants was *weighing yourself on a regular basis to prevent weight gain.* This strategy ranked sixth for the unsuccessful participants, and this group weighed themselves regularly less than 46% of the time. Also among the top five strategies for all groups was *increasing your daily physical activity (take the stairs, park further away, walk instead of drive)*.

Participants were asked if they had regained 2 or more pounds during the 18-month period, and 89 individuals answered "yes." Those who responded affirmatively were asked to indicate what percentage of the time they used their restart plan to prevent further weight gain. The mean percentage of the time individuals used the restart plan was low for the total sample and all groups, ranging from 35.4% to 46.4% of the time (Table 5.2).

We checked for differences in behavioral strategy use between the black and white participants and the successful and unsuccessful participants. We found only one significant difference in strategy use between the racial groups, *modifying recipes when making foods*, $t_{(105)} = 2.01$, $p = .04$. Black participants used this strategy less frequently ($M = 45.0\%$, $SD = 31.0\%$ of the time) than white participants ($M = 56.8\%$, $SD = 24.3\%$ of the time). However, no differences in strategy use were found between the successful and unsuccessful participants, ps > .17.

Additionally, we examined the use of behavioral strategies for weight maintenance for successful and unsuccessful participants within and between each racial group. Again, the most commonly used strategy for all groups was reading food labels. Mean percentages of the time groups used this strategy (with standard deviations in parentheses) were 66.8% (25.1%), 66.4% (31.0%), 67.7% (26.9%), and 55.0% (36.1%) for successful white, successful black, unsuccessful white, and unsuccessful black participants, respectively. When assessing for differences in strategy use between the successful white (n = 47) and successful black (n = 14) participants, we found no significant differences between these subgroups; the percentage of the time that the restart plan was used to prevent further weight gain was marginally significant, U = 132.5, Z = -1.85, p = .07, all other ps > .19. Successful white participants used their restart plan less (M = 35.0%, SD = 27.6% of the time) than successful black participants (M = 53.6%, SD = 28.4% of the time). A comparison of unsuccessful white (n = 34) and unsuccessful black (n = 12) participants revealed a significant difference between the two groups in the amount of time that portion control methods were used to control food intake, $t_{(44)}$= 2.22, p = .03 (M = 44.7%, SD = 28.2% and M = 24.2%, SD = 25.7% for unsuccessful white participants and unsuccessful black participants, respectively). No differences in strategy use were found within racial groups between successful white and unsuccessful white participants, ps > .35, or between successful black and unsuccessful black participants, ps > .14.

5.5 DISCUSSION

The purpose of this study was to examine the use of behavioral strategies for weight maintenance 18 months after the completion of a behavioral weight loss trial. We found that the most popular

behavioral strategy used in this follow-up period was reading food labels. This strategy had the highest mean usage for the total sample and all groups. Others have reported a significant association between label reading and decreased fat intake in population-based surveys (Guthrie & Saltos, 1995; Neuhouser, Kristal, & Patterson, 1999; Satia, Galanko, & Neuhouser, 2005). Another trial reported that 96% of the participants stated they paid more attention to the number of fat grams and amount of cholesterol in the items they bought because of label reading (Medeiros & Zies, 1996). The PREFER trial's weight loss intervention emphasized limiting fat intake as a means of reducing caloric intake, and PREFER II found that participants reported using food label reading as a means of increasing their awareness of the nutritional content of foods. An interesting follow-up question might have been, "After reading the label, did you elect not to purchase foods that were high in calories or fat grams?" since our question did not inquire about whether or not reading the label actually influenced their behavior. However, a majority of the participants were successful weight maintainers suggesting that the use of this strategy increased awareness of calorie and fat content and might have resulted in individuals not purchasing unhealthful items.

We found one significant difference in behavioral strategy use between the black and white participants in PREFER II; white individuals modified recipes to reduce or eliminate high-fat or high-calorie ingredients more often than black individuals. The intervention materials for the PREFER trial were based upon the established method of standard behavioral therapy for weight loss but were not tailored to the specific eating or food preparation preferences of any cultural group, keeping in mind that the influence of cultural factors on preferences may vary considerably among individual members of a racial group (Kumanyika & Morssink, 1997). Yet, changing certain food practices within racial or ethnic groups might be resisted as these practices

are sometimes perceived as components of valuable cultural traditions (Airhihenbuwa et al., 1996; Dacosta & Wilson, 1996), and substituting ingredients that have cultural ties with more healthful alternatives may not have appealed to some of the black participants in our study. We also found a significant difference in the mean percentage of the time that portion control methods were used between unsuccessful black and unsuccessful white participants. Although both unsuccessful groups used this strategy for less than half the time, black individuals reported using portion control significantly less often than white persons did. An explanation for this finding of a between-race difference is not known but could possibly be attributed to the pressure to overeat in social situations that some black women have reported (Gans et al., 2003) or the importance of the shared social experience associated with eating for some black persons (Airhihenbuwa et al., 1996; Kumanyika, 2002), which could lead to less attention being paid to portion control.

A somewhat surprising finding was that most strategies learned during the PREFER trial were not used a majority of the time. The number of strategies that were used for more than half the time among the groups ranged from 2 to 4 of the 16 strategies. Other researchers have noted that participants do not continue to use behavioral strategies after weight loss treatment with only two strategies— eating in appropriate locations (kitchen, dining room) and eating only one portion at a meal— used for more than half of the follow-up period (Stalonas, Perri, & Kerzner, 1984). Yet, the majority of the participants in our study were considered successful at weight maintenance despite having used most strategies for less than half the time. A high usage of behavioral strategies is associated with improved weight maintenance (Befort et al., 2007; Kitsantas, 2000; Leser et al., 2002; McGuire et al., 1998; Wing & Hill, 2001), which is contradictory to our results. A possible explanation for these findings is that the survey required

the participant to recall what percentage of the time over the previous 18 months that he/she used each strategy. The recollection of behaviors over an extended period of time could have introduced inaccurate reporting as empirical findings suggest that the human memory is not trustworthy and the process of recalling information has the potential to introduce imprecision and bias (Hufford & Shiffman, 2003). An alternative explanation is that participants were using other strategies for weight maintenance that were not inquired about in the survey.

We found that there were no differences in behavioral strategy use between the successful and unsuccessful weight maintainers. A recent nationwide survey also found that the five most commonly reported behavioral strategies for weight control— eating a smaller amount of food, more fruits and vegetables, smaller portion sizes, fewer high-fat foods, and no sugared beverages— did not differ between those who had lost weight and kept if off compared to those who were unsuccessful at weight loss and maintenance (Kruger, Blanck, & Gillespie, 2006). Regular self-weighing has received particular attention recently as being associated with successful maintenance (Butryn, Phelan, Hill, & Wing, 2007; Kruger et al., 2006; Wing et al., 2006). Although there was not a significant difference in the use of this strategy between the successful and unsuccessful participants in our study, successful individuals did report weighing themselves for a greater proportion of the time. Perhaps the difference between these two groups might have been that the unsuccessful persons did not take corrective actions after seeing a weight gain on the scale. The finding of no significant differences between successful and unsuccessful participants could also be because of the nature of self-report data where it is difficult to determine whether actual behaviors are different. Additionally, previous research has found that some individuals fail to correctly estimate their eating and activity behaviors

(Lichtman, Pisarska, Berman, Pestone, Dowling et al., 1992; Muhlheim, Allison, Heshka, & Heymsfield, 1998).

Several strengths and a few weaknesses of this study exist. PREFER II was a long-term assessment of weight maintenance after behavioral weight loss treatment that adds to the limited amount of literature reporting on longer-term weight maintenance, since many trials do not examine maintenance beyond a year after weight loss (Early et al., 2007; Fogelholm et al., 1999; Harvey-Berino, Pintauro, & Gold, 2002; LeCheminant et al., 2005). We also investigated the strategies used by black individuals for weight maintenance, a group that has not been well-studied in terms of weight management (Kumanyika, Gary et al., 2005). Furthermore, 90% of the participants who completed the weight loss trial returned for PREFER II, reducing the potential for bias from a differential return of only those who maintained their weight. The main limitation of this study is the collection of self-report data. Although this method is the only means of collecting information on strategies used for weight maintenance, self-report is subject to social desirability as well as inaccuracy because of the limitations associated with participant recall, as discussed earlier. Fifty percent of the black participants and 62% of the white particpants had a mean annual household income of ≥ $50,000; the mean education level was also somewhat high at 15.4 years for Whites and 14.7 years for Blacks. Thus, these results might be considered generalizable to persons with a higher socioeconomic level. Moreover, because health disparities are associated with low socioeconomic status (Lantz et al., 1998; Sorlie, Backlund, & Keller, 1995), examining behaviors used for weight maintenance in a sample that had a more diverse representation of education and income levels would be valuable. Additionally, we were unable to identify what behavioral differences existed between the successful maintainers and those who

were unsuccessful. Further exploration is warranted to determine what facilitated the success of the maintainers and what might have been missing for the unsuccessful group.

In conclusion, we found that most of the weight-control strategies participants learned during the PREFER trial's weight loss intervention were not often used in the 18 months following the study. Additional investigations should explore why strategies are not used after treatment ends so that future interventions can be modified to encourage participants' continuation of these strategies beyond the intervention period. No differences between successful and unsuccessful participants and few differences between black and white participants existed. Yet, further study could be directed toward incorporating culturally-tailored strategies into weight management programs in order to support the weight-control efforts of black individuals. This could include specific instruction on how to prepare healthier ethnic meals (Gans et al., 2003) or providing cookbooks for ethnic-style foods, e.g., Heart-Healthy Home Cooking African American Style (Kumanyika, Shults et al., 2005; U.S. Department of Health and Human Services, 1997). Even though more than half of participants were considered successful weight maintainers, future research must focus on determining how individuals make behavioral choices about weight management in order to establish ways to promote healthful dietary and activity behaviors long-term.

Table 5.1: Sociodemographic and Baseline Characteristics for PREFER II Sample

	Total (*N* = 107)	**White (*n* = 81)**	**Black (*n* = 26)**	**Difference between groups**	
Variable	***n (%)***	***n (%)***	***n (%)***	χ^2	***p***
Gender					
Female	92 (86.0)	67 (83.0)	25 (96.0)	0.05[c]	.11
Male	15 (14.0)	14 (17.0)	1 (4.0)		
Marital Status[a]					
Married/living with partner	75 (70.8)	63 (79.0)	12 (46.0)	10.08	<.01
Not married/separated	31 (29.2)	17 (21.0)	14 (54.0)		
Employment[b]					
Full time	83 (79.1)	59 (74.7)	24 (92.4)		
Part time	10 (9.5)	9 (11.4)	1 (3.8)	3.13[c]	.21
Other	12 (11.4)	11 (13.9)	1 (3.8)		
Income[a]					
≤ $30,000/yr	16 (15.1)	12 (15.0)	4 (15.4)		
$30-50,000/yr	27 (25.2)	18 (22.5)	9 (34.6)	1.74[c]	.44
≥ $50,000/yr	63 (58.9)	50 (62.5)	13 (50.0)		
	Mean SD	***Mean SD***	***Mean SD***	***U***	***p***
Variable	***Median***	***Median***	***Median***	***z***	
Education (years)	15.3 2.6	15.4 2.5	14.7 2.7	856.5	.15
(Range: 12-23)	16.0	16.0	14.5	-1.45	
Age (years)	46.3 6.9	46.1 7.1	46.8 6.4	1006.0	.73
(Range: 20-55)	48.0	48.0	48.5	-0.34	

	Total (*N* = 107)		**White (*n* = 81)**		**Black (*n* = 26)**		**Difference between groups**	
Variable	***Mean*** ***Median***	***SD***	***Mean*** ***Median***	***SD***	***Mean*** ***Median***	***SD***	***t***	***p***
Weight (lbs)	193.9	33.3	191.7	33.5	200.7	32.4	-1.20	.23
(Range: 126.7-264.4)	192.9		192.0		199.1			

Note. SD = Standard deviation; *U* = Mann Whitney U; *t* = t-value *p* = p-value; *z* = z-value.

[a]One white participant had missing data. [b]Two white participants had missing data. [c]Fisher's exact test.

Table 5.2: Percentage of the Time Each Behavioral Strategy was Used by the Total Sample and Each Group

	Total (***N*** **= 107)**		**Black** (***n*** **= 26)**		**White** (***n*** **= 81)**		**Successful** (***n*** **= 61)**		**Unsuccessful** (***n*** **= 46)**	
Strategy- "How often did you..."	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***
1. Read food labels while grocery shopping looking at total calories, fat grams, and healthy claims ("reduced fat," "low-cal", "light")?	65.7	27.7	61.2	33.3	67.2	25.7	66.7	26.3	64.3	29.6
2. Feel you had the support of family and friends for sticking to your healthy eating and physical activity plan?	54.6	33.2	53.8	33.7	54.8	33.2	55.9	33.9	52.8	32.4
3. Modify your recipes when making foods (reducing or substituting high-fat or high-calorie ingredients with healthier choices)?	53.9	26.4	45.0	31.0	56.8	24.3	54.5	27.4	53.0	25.3
4. Increase your daily physical activity (take the stairs, park further away, walk instead of drive)?	51.6	27.9	50.4	27.2	51.9	28.4	49.8	29.1	53.9	26.4

	Total (N = 107)		Black (n = 26)		White (n = 81)		Successful (n = 61)		Unsuccessful (n = 46)	
Strategy- "How often did you..."	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***
5. Use weighing yourself on a regular basis to prevent weight gain?	48.6	32.4	46.2	36.6	49.4	31.2	50.7	33.3	45.9	31.4
6. Handle cues (triggers) in your surroundings that may promote unhealthy choices (popcorn at the movies, snacking while watching T.V., high calorie vending machines) and select a healthier choice?	46.0	26.0	42.3	27.3	47.2	25.6	46.4	26.0	45.4	26.3
7. Self-monitor your physical activity including type of activity and total minutes?	44.0	30.5	40.8	29.1	45.1	31.1	41.5	31.8	47.4	28.8
8. Use problem-solving tips in situations where it is difficult to follow a healthy eating plan (e.g., eating a healthy snack before a party, ordering from a light menu, packing a low-calorie lunch for work)?	43.4	27.2	40.0	29.5	44.4	26.5	42.9	27.1	43.9	27.7

	Total (*N* = 107)		Black (*n* = 26)		White (*n* = 81)		Successful (*n* = 61)		Unsuccessful (*n* = 46)	
Strategy- "How often did you..."	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***
9. Include scheduled physical exercise in your day?	43.1	30.9	38.5	29.4	44.6	31.4	42.1	32.6	44.3	28.8
10. Change negative thoughts you were having (excuse-making, "all or nothing" thinking, pessimism) that could interfere with your healthy eating and physical activity plan?	41.3	27.4	43.1	31.7	40.7	26.0	39.3	27.2	43.9	27.6
11. Use increasing physical activity to prevent weight gain?	41.3	28.9	36.2	27.9	43.0	29.2	42.5	30.0	39.8	27.8
12. Use portion control methods (weighing your food, using references of serving size, etc.) to control your food intake?	39.2	28.0	32.3	26.1	41.4	28.4	39.0	27.7	39.3	28.8

	Total (N = 107)		Black (n = 26)		White (n = 81)		Successful (n = 61)		Unsuccessful (n = 46)	
Strategy- "How often did you..."	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***
13. Practice being assertive with others to meet your healthy lifestyle goals (e.g. reminding others of your healthy eating plan and not giving in to pressure to eat)?	38.5	30.7	37.3	30.7	38.9	30.9	39.2	30.1	37.6	31.9
14. Self-monitor your food intake including total calories and total fat grams?	37.4	28.2	38.5	31.6	37.0	27.2	40.7	29.3	33.0	26.3
15. Use reminders in your surroundings for doing physical activity (keep tennis shoes in sight, set an alarm to remind you to be active, make an activity date with a friend)?	35.4	30.3	32.3	26.1	36.1	31.0	34.9	32.2	36.1	27.8
Did you regain 2 or more pounds?	Yes, n = 89		Yes, n = 22		Yes, n = 68		Yes, n = 49		Yes, n = 40	
• How often did you use your "restart plan" to prevent further weight gain?	38.1	27.9	46.4	29.8	35.4	37.0	39.2	28.6	36.7	27.5

6.0 RESULTS MANUSCRIPT #3

Dietary Intake and Physical Activity as Potential Mediators of the Relationship between Psychosocial Variables and Weight Maintenance

6.1 ABSTRACT

Objective: To explore the roles of calorie intake, fat gram intake, and physical activity as potential mediators of the relationship between weight maintenance and barriers to healthy eating, low-fat diet experiences, self-efficacy, social support and stress. **Methods**: PREFER II was an ancillary study to assess predictors and mediators of weight maintenance 18 months after the completion of a behavioral weight loss trial. We weighed participants in light clothing without shoes and used the following instruments to measure psychosocial variables: Barriers to Healthy Eating (BHE), Experiences Following a Low-Fat Diet (ELF), Weight Efficacy Lifestyle (WEL), and Self-Efficacy for Exercise. We measured social support with a composite variable of two subscales from the ELF and BHE and measured stress from four survey items. Dietary intake was assessed using two 24-dietary recalls, and physical activity was measured by the Paffenbarger Activity Questionnaire. We employed linear regression models to examine the relationship of psychosocial variables with percent weight change and the potential mediation effects of dietary intake and physical activity. **Results**: The sample (N = 116) was mostly female

(85.0%) and middle-aged (*M* = 45.9, *SD* = 7.5 years). Dietary intake and physical activity did not mediate the relationship between psychosocial predictors and weight maintenance; however, the BHE, ELF, WEL and the effect of a stressful life event on eating were significant predictors of weight change, *p*s < .03. An increase in the BHE also predicted increased fat gram intake, *p* = .048. **Conclusions**: Dietary intake and physical activity were not mediators of weight change after a behavioral weight loss trial, but these results identify several target areas, e.g. decreasing barriers to healthy eating and augmenting stress-management skills, for future directions in weight maintenance interventions.

6.2 INTRODUCTION

With the national and global rates of obesity at an all-time high (Eckel et al., 2004; Ogden et al., 2006), research is needed to understand the mechanisms by which an increasing number of individuals are at an unhealthy weight. Because weight loss programs seem to be beneficial for helping individuals lose weight initially (Jeffery et al., 2000), of particular interest is the problematic aspect of weight regain after treatment. Evidence suggests that several factors are associated with successful weight maintenance after a loss, e.g., self-efficacy (DePue et al., 1995), social support (Perri, Sears, & Clark, 1993; Wolfe, 2004), and a capacity for coping with life stress (Elfhag & Rossner, 2005). Developing a dislike for the taste of fat has been documented among those adherent to a low-fat diet (Urban et al., 1992), which could promote weight maintenance in the long-term, while barriers to eating a healthy diet are an inhibiting factor (Andajani-Sutjahjo et al., 2004; Davis et al., 2005). Yet, little information is available regarding how these variables influence weight maintenance.

Certain process variables might be responsible for or mediate the effect of psychosocial factors on weight management. For example, reduced caloric intake and increased physical activity are necessary for weight loss, and empirical evidence shows that continuation of these behaviors long-term is beneficial for weight maintenance (Shick et al., 1998; Wing & Phelan, 2005). It is possible that psychosocial factors, e.g., self-efficacy, social support, may exert their influence on weight management through an effect on dietary intake and physical activity. Some studies have examined the role of mediators of weight loss (Linde et al., 2006; Perri et al., 2001; Pescatello & VanHeest, 2000; White, Martin, Newton, Walden, York-Crowe et al., 2004), but no investigations were found examining mediators of weight maintenance after a weight loss trial. Therefore, the purpose of this study was to explore dietary intake, i.e., calorie and fat gram intake, and physical activity as possible mediators of the relationships between weight maintenance after a behavioral weight loss trial and 1) barriers to healthy eating, 2) experiences associated with following a low-fat diet, 3) self-efficacy for resisting eating and for exercising, 4) social support, and 5) stress. In statistical mediation, a mediator variable affects the relationship between the independent and dependent variables of interest and is the means through which a predictor influences the outcome variable (Baron & Kenny, 1986). This phenomenon is depicted in Figure 6.1. For example, we explored if each psychosocial predictor affected weight maintenance (path a) and affected the mediator (path b). In path c, the mediator should significantly predict weight maintenance after controlling for the psychosocial predictor. A significant test of mediation would result if, after controlling for the influence of the mediator on weight maintenance, the effect of the psychosocial predictor on weight maintenance (path a) was eliminated (complete mediation) or reduced (partial mediation) (Baron & Kenny, 1986).

6.3 METHODS

This follow-up study, PREFER II, took place 18 months after the end of a randomized clinical trial of behavioral weight loss treatment, PREFER. For PREFER, persons were recruited from the community in three cohorts and were randomly assigned to receive their preferred dietary intervention or not receive their preference (Preference-Yes or Preference-No) as well as to one of two dietary plans— a reduced-calorie and reduced-fat standard diet or a reduced-calorie and reduced-fat lacto-ovo-vegetarian diet. Standard behavioral therapy for weight loss was used during the course of the one-and-a-half year trial with group intervention sessions decreasing in frequency over time. Further details concerning the design and findings of the PREFER trial have been published elsewhere (Burke, Choo et al., 2006; Burke et al., 2007; Burke, Styn et al., 2006; Burke, Warziski et al., 2008). At the completion of the trial, the mean weight loss was between 4% and 8% for the four groups with a similar observed weight loss for participants in the lacto-ovo-vegetarian diet groups compared to the standard diet groups. A larger weight loss was observed for persons randomly assigned to not receive their preference compared to persons who were randomized to receive their preferred dietary treatment (Burke, Warziski et al., 2008).

For PREFER II, we contacted participants to return for a follow-up investigation 18 months after the PREFER trial had ended. Individuals were not informed during their time in PREFER that any future study would take place, and we did not contact participants prior to requesting their participation in PREFER II. We measured participants' weights and several factors believed to be related to weight maintenance (barriers to healthy eating, experiences associated with following a low-fat diet, self-efficacy for resisting eating and for exercising, stress, social support, calorie and fat gram intake, and physical activity). The inclusion and exclusion criteria of PREFER established the eligibility criteria for PREFER II— 18-55 years

old, agreeable to random assignment to their treatment preference or not and one of the two diet interventions, body mass index (BMI) between 27 and 43 kg/m^2, and submitted an adequately completed 5-day food diary. Individuals were excluded if they had a medical condition that required they follow a physician-managed diet or activity plan (e.g. diabetes, recent myocardial infarction), had physical problems that limited their ability to exercise, their alcohol intake exceeded four or more daily drinks, or their regular food intake did not include meat, fish or poultry. Persons were also excluded because of pregnancy or a planned pregnancy during PREFER, treatment for a psychological diagnosis, current use of weight loss pharmacotherapy or participation in a weight loss program within the past six months. The baseline measure for PREFER II was the PREFER final assessment; thus individuals were required to have completed PREFER in order to participate in PREFER II. One hundred nineteen, or 90%, of the individuals in 3 cohorts who finished PREFER participated in PREFER II between February 2006 and April 2007. Three of these 119 participants were excluded from PREFER II as two were pregnant and one indicated that she had a binge eating disorder, for a sample size of 116.

6.3.1 Weight

The Tanita Digital Scale was used to measure weight in pounds with participants wearing light clothing and no shoes. For one out-of-town participant, we obtained a self-reported current weight. Self-reported weights have been noted as valid in previous studies (Kuczmarski et al., 2001; Spencer et al., 2002), and two kilograms were added to this self-reported value to correct for possible under-reporting. This corrective action has been reported by others (Kramer et al., 1986; Linde, Jeffery et al., 2004; Palta et al., 1982).

6.3.2 Psychosocial predictors

Psychosocial variables of interest included the Experiences Associated with Following a Low-fat Diet Scale (ELF), Barriers to Healthy Eating Scale (BHE), Weight Efficacy Lifestyle Questionnaire (WEL), Self-Efficacy for Exercise Scale (SEE), social support and stress. A composite score of three items from the BHE scale and four items from the ELF scale measured family and friend social support as determined by factor analysis (Burke et al., 2004; Kim et al., 2004). Four survey items assessed stress: "Have you had a major stressful event (such as marriage, new job, divorce, death in the family) in the last 18 months? If yes, please describe." "On a scale of 0 (no effect) to 10 (most effect), how much did this stressful event affect your eating habits?" "On a scale of 0% to 100% of the time, how often does stress influence how you eat?" "On a scale of 0% to 100% of the time, how often do you use tricks to lower your stress level (deep breathing, journal writing, exercise, relaxing hobbies, time management, etc.)?" We developed the survey for PREFER II and pilot tested it in a group of individuals seeking weight loss treatment who found it easy to follow and complete. We administered the ELF, BHE and WEL in PREFER and PREFER II, but the SEE and the four survey items measuring stress were included in PREFER II only.

The ELF questionnaire measured experiences believed to be associated with the maintenance of a low-fat diet— wellness (feeling healthier when following the diet), distaste (for fat), cost (financial and time), inconvenience (following the diet when not eating in the home), deprivation (denied favorite foods), and family (inadequate family support). It has a 5-point scale (1 = strongly disagree to 5 = strongly agree) and was validated during the Women's Health Trial (r = .26 to .76) (Urban et al., 1992). Higher scores denoted experiences that are more positive. Cronbach's alpha for this study was satisfactory at .81 (Nunnally & Bernstein, 1994).

In the BHE questionnaire, participants rated on a scale of 1 (no problem) to 5 (very important problem) different situations associated with adhering to the healthy eating plan (emotions, daily mechanics of following the eating plan, social support), e.g., "It is difficult to motivate myself to eat appropriately" or "Changing my diet to reduce calories and fat seems too complicated." Higher scores indicated more barriers. In the PREFER trial, Cronbach's alpha was .86 (Burke et al., 2004), and $\alpha = .89$ for PREFER II suggesting good internal consistency.

The WEL questionnaire assessed self-efficacy for weight management (Clark et al., 1991). This tool assessed the participant's confidence in the ability to resist eating under varying circumstances on a scale of 0 to 9, e.g., "I can resist eating when I am at a party." Higher scores indicated greater confidence. Psychometric properties are well-established (Clark et al., 1991), and Cronbach's alpha for this study was high at .94. The validity and reliability of this measure was also established in African American women (Dutton et al., 2004).

Administered only at PREFER II, the SEE is a measure of self-efficacy for exercise (Resnick & Jenkins, 2000) in which individuals were asked to rate, on a scale of 0 (not confident) to 10 (very confident), their confidence in their ability to exercise 3 times per week for 20 minutes given a variety of conditions, e.g. you were busy with other activities or you felt tired. Higher scores indicated greater confidence in the ability to exercise. Good internal consistency ($\alpha = .92$) has been reported (Resnick & Jenkins, 2000). Cronbach's alpha coefficient for PREFER II was comparable at .93.

Three items from the BHE and four items from the ELF were combined as a measure of one's perception of his/her social support from friends and family for following a healthy eating lifestyle. A lower score indicated less social support. Cronbach's alpha was .78 indicating acceptable internal consistency for this measure of social support.

6.3.3 Potential mediators

Two unannounced 24-hour dietary recalls, which have been shown to be reliable in adults and children (Conway, Ingwersen, & Moshfegh, 2004; Freund, Johnson, Silverstein, & Thomas, 1991), were conducted to collect dietary intake data in PREFER II. The trained interviewer used the Nutrition Data System for Research (NDSR) software, and comprehensively reviewed, for one workday and one non-working day, all foods and drinks the participant consumed in the previous 24 hours. The NDSR software, maintained by the Nutrition Coordinating Center at the University of Minnesota (The University of Minnesota Nutrition Data System for Research, www.ncc.umn.edu, accessed 5 June 2008), contains over 18,000 foods, 8,000 brand name products, and a number of ethnic and regional food items. We instructed participants on how to complete the dietary recall and provided measurement references to help them judge their portion sizes. The dietary data from the PREFER study final assessment came from 3-Day Food Diaries where participants recorded everything that they ate or drank on 2 working days and one leisure day. A dietician reviewed these diaries with each participant for completeness and accuracy. The data from the diaries were also analyzed using this same nutrient software. We derived an average calorie and fat gram intake for the PREFER final assessment and for PREFER II.

In PREFER and PREFER II, we measured physical activity by self-report via the Paffenbarger Activity Questionnaire (PAQ) (Paffenbarger, Wing, & Hyde, 1978), which provides an estimation of kilocalorie (kcal) expenditure for the past week through the assessment of number of city blocks normally walked each day, number of flights of stairs climbed daily, and leisure-time activities, e.g., total minutes of sports or recreational activities. A total weekly score for energy expenditure in kcals is derived by assiging 8 kcal to each city block, 4 kcal to

each flight of stairs and 5 kcal/min, 7.5 kcal/min or 10 kcal/min to light, moderate, or vigorous leisure-time activities, respectively. The PAQ has shown good test-retest reliability (r = .34 to .72), and validity is reported as r = .29 with Caltrac Physical Activity Monitors and r = .62 with VO_2 max (Ainsworth, Haskell, Leon, Jacobs, Montoye et al., 1993).

6.3.4 Statistical analysis

SPSS (version 15.0, SPSS Inc., Chicago, IL 2006) was used for the analysis, and an alpha level of .05 was set for all two-sided hypothesis testing. Descriptive statistics (means, standard deviations, medians) were used to describe the study sample. As appropriate, we used chi-square tests of independence, Fisher's exact tests and *t*-tests or Mann Whitney U tests to examine sociodemographic and baseline variables for differences between those who participated in PREFER II and those who did not. We used percent change scores for all variables (predictor, mediator, dependent), i.e., change from baseline to PREFER II standardized by percent change from baseline, except for the SEE and three continuous stress items because we collected these variables only at PERFER II. Path analysis was employed to asses the roles of dietary intake (calorie and fat gram intake) and physical activity as possible mediators of the relationship between weight maintenance (percent change in weight) and the predictor variables (barriers to healthy eating, low-fat diet experiences, self-efficacy for resisting eating and for exercising, social support, stress). In order to examine mediation, regression models analyzing both the direct effect of each of the predictors on weight maintenance and their indirect effects through dietary intake and physical activity were fitted. According to Baron and Kenny (1986), we established three regression equations for each predictor, as appropriate. We first regressed the dependent variable (weight maintenance) on the predictor. If this regression model was

significant, we regressed each possible mediator on the predictor in the second step. If a mediator was significantly predicted by the predictor variable, we regressed the dependent variable on both the predictor and the mediator simultaneously in the third step (Baron & Kenny, 1986). The estimation of effect sizes using standardized path coefficients was examined rather than the strict testing of hypothesized relationships. Assumptions underlying simple linear regression i.e., normality of the error terms, homoscedasticity of error variance, independence of observations, linearity of variables, no outliers, were supported once the following remedial strategies were applied and influential outliers were removed from various models.

Two remedial strategies were employed with the PAQ scores for physical activity prior to conducting the regression analyses with this variable. Two participants reported no physical activity at baseline and one of these same persons reported no activity at PREFER II, giving them improbable zero scores. These zero values were handled using score alteration where these values were replaced with a value that was one kcal less than the lowest reported kcal expenditure for the sample so that they remained the lowest ranked value (Tabachnick & Fidell, 2001). Four participants' percent change scores were extreme and beyond the sample distribution at PREFER II; thus, these scores were also handled with score alteration and replaced with one percent above the highest score near the sample distribution, making them the highest ranked scores. Despite the application of these remedial measures, all histograms of standardized residuals with percent physical activity change in the model revealed a highly positively skewed distribution. Therefore, a log base 10 transformation was applied to the physical activity variable; this transformation was adequate to support the statistical assumptions. A square root transformation was utilized for the percent calorie change and percent fat gram change variables as histograms of standardized residuals showed moderately positively skewed

distributions; these transformations were also adequate to support the underlying assumptions of the regression model. Prior to data transformation, a constant value was added to variables that contained zero or negative values.

Sensitivity analyses were performed with and without potential outlying values, and nine influential outliers were identified in various regression models— two in the BHE, two in the WEL, one in physical activity, three in social support, and one in weight change predicted by the use of stress reducing techniques. These individuals were therefore removed from models in which they overly influenced the results. The first outlier was a 47-year-old white woman who experienced a 126% increase in barriers to healthy eating; her baseline BHE score was in the bottom 20% of the sample, but increased to the highest quartile of the sample. She lost 2 lbs (0.96%) during the PREFER trial and gained 7.7 lbs or 3.82% of her weight at PREFER II. A 46-year-old black woman had a 123% increase in her barriers to healthy eating score; her baseline BHE score was the fifth lowest in the sample and increased to the 50th percentile. She gained weight (1.7 lbs or 0.65%) during PREFER and gained an additional 10.8 lbs (4.07%) at PREFER II. One 53-year-old white woman had a 262.0% increase in self-efficacy for resisting eating (WEL) with the lowest score at baseline and a score that remained within the lowest quartile at follow-up. She lost 7.7 lbs (2.9%) during PREFER and gained 16 lbs (6.25%) at follow-up. The other outlier in the WEL was a 52-year-old white woman who had a 175% increase in her WEL score; she had the second lowest score at baseline and her score remained in the bottom third of the sample at follow-up. She gained 10.0 lbs (4.7%) during PREFER and gained 19.1 lbs (7.8%) at PREFER II. A 55-year-old black woman was an influential outlier when examining whether the WEL predicted physical activity. This woman had a 98.2% increase in her WEL score (the fourth lowest score at baseline to slightly below the fiftieth percentile at follow-up) and her

physical activity increased by 1791.9%. She reported no physical activity at baseline and 2629.8 kcal of physical activity at follow-up. Her baseline score and percent change score were part of the scores that underwent score alteration as described earlier.

Three outliers were identified when examining social support as a predictor of weight change. One was a 53-year-old white woman with a 100% increase in social support and the lowest score of the sample at baseline that remained in the bottom 10% of the sample at follow-up. She lost 5.5 lbs (2.5%) during PREFER and regained 1.5 lbs (0.7%) at follow-up. A 54-year-old white woman had an increase in social support of 94.4% with a score in the bottom 10% at baseline that increased to the highest possible score at follow-up. During PERFER, she lost 15.8 lbs (7.6%) and regained 1.5 lbs (0.7%) at PREFER II. The third outlier in this model was a 44-year-old black woman with an 83.3% increase in social support; her score was the second lowest at baseline and stayed in the bottom quartile of the sample at follow-up. She had no change in weight at the completion of PREFER and gained 11.8 lbs (6.7%) at PREFER II.

The last influential outlier was identified in the model with weight change predicted by the item, “On a scale of 0% to 100% of the time, how often do you use tricks to lower your stress level (deep breathing, journal writing, exercise, relaxing hobbies, time management, etc.)?” This 47-year-old black woman reported using stress reduction techniques for 0% of the time. She lost 55.7 lbs (24.8%) during the course of PREFER and regained 45.5 lbs (27%) at PREFER II.

6.4 RESULTS

Sociodemographic characteristics of the 116 participants are presented in Table 6.1, and baseline, PREFER II follow-up, and percent change variables are shown in Table 6.2. The

sample was an average of 45.9 years old (*SD* = 7.5 years). Participants were mostly female (85.0%), married or living with a partner (69.0%) and well educated (*M* = 15.3, *SD* = 2.5 years of education). They reported consuming an average of approximately 1488 calories and 47 grams of fat per day and expending about 3000 kcal in physical activity a week at baseline. Calorie and fat gram intake increased to a mean of 1712 calories and 64 grams of fat daily while energy expenditure decreased to 2306 kcal a week at follow-up. Participants who returned for PREFER II did not significantly differ from individuals who did not return for PREFER II in sociodemographic variables (age, gender, race/ethnicity, education, income, marital status, *p*s > .12) or baseline variables (weight, BHE, ELF, WEL, social support, calorie or fat gram intake or physical activity, *p*s > .08).

Table 6.3 shows the results of univariate regression models for each psychosocial variable predicting percent weight change. Self-efficacy for exercise, social support, how often stress influences eating, and how often participants used stress reduction techniques were not significant predictors of weight maintenance; therefore, the exploration of mediation was not pursued with these variables. The BHE, ELF and WEL as well as how much a stressful life event affected eating, in the subsample of participants who reported a stressful event, were significant predictors of weight maintenance. An increase in barriers to healthy eating and an increase in the effect of a stressful event on eating were associated with weight regain whereas a decrease in positive experiences associated with following a low-fat diet and a decrease in self-efficacy for resisting eating were associated with weight regain. Thus, calorie and fat gram intake and physical activity were explored as possible mediators of the relationship between these variables and weight change.

The potential mediators of calorie intake, fat gram intake and physical activity were not significantly predicted by the ELF (*p*s > .40), the WEL (*p*s > .11), or the effect of a stressful life event on eating (*p*s > .06). See Table 6.4. The BHE did not significantly predict calorie intake (*p* = .55) or physical activity (*p* = .29), but was a significant predictor of fat gram intake. An increase in barriers to healthy eating was associated with an increase in fat gram intake. BHE and fat gram intake were then regressed on percent weight change together. In this step, the potential mediator, fat gram intake, did not significantly predict percent weight change (*p* = .58), and statistical mediation of the effect of BHE on weight maintenance was not supported. See Figure 6.2 for standardized regression coefficients.

6.5 DISCUSSION

Our findings did not support the roles of dietary intake and physical activity as mediators of the relationships between psychosocial variables and weight maintenance 18 months after a behavioral weight loss trial. We did find that barriers to healthy eating, experiences associated with following a low-fat diet, self-efficacy for resisting eating, and the impact of a stressful life event on eating were associated with weight change. Additionally, an increase in barriers to healthy eating predicted increased fat gram consumption in this follow-up study. Others have reported barriers related to healthful dietary intake that could affect weight maintenance (Eikenberry & Smith, 2004; Vijan et al., 2005). One of the major reported barriers to healthy eating in a study of weight maintenance was a concern about the taste of more healthful foods (Andajani-Sutjahjo et al., 2004). Because foods high in fat are often thought of as having more taste (Astrup, Toubro, Raben, & Skov, 1997), difficulty limiting fat intake may be a important

barrier to weight maintenance, as successful weight-loss maintainers report continuing to follow a diet low in fat (Shick et al., 1998). Research has focused on continuing to eat a low-fat diet as a method of weight management (Astrup et al., 2000; Lindstrom et al., 2006; Shick et al., 1998; Swinburn et al., 2001); therefore, helping individuals keep in mind the positive aspects of this eating plan, e.g. cardiovascular risk reduction, feeling healthier, may be essential to promoting the continuation a diet lower in fat.

Unsuccessful weight maintenance is related to inadequate coping or problem-solving skills (Drapkin et al., 1995; Kayman et al., 1990), which might have been present in the subsample of individuals who reported experiencing a stressful life event. We did not inquire about specific strategies participants used to cope with the stressful life event, but the moderately high mean score of 7.1 out of 10 for the effect of the event on eating habits suggests that these individuals might use eating to cope with stress. Moreover, the physiologic effects of stress can increase appetite and food intake (Newman et al., 2007; Tataranni, Larson, Snitker, Young, Flatt et al., 1996), reinforcing the value of using a constructive manner of coping with stress. Future studies should explore problem solving and stress management techniques as a means of preventing weight regain.

The role of self-efficacy in weight loss has been extensively studied (Dennis & Goldberg, 1996; Linde, Jeffrey, Levy, Sherwood, Utter et al., 2004; Richman, Loughnan, Droulers, Steinbeck, & Caterson, 2001); however, less is known about the influence of self-efficacy on weight maintenance. While we found self-efficacy was associated with weight change, the effect was not mediated through dietary intake or physical activity. Linde and associates found that the effect of self-efficacy on weight loss during treatment was mediated by weight control behaviors, e.g., the number of days participants followed the dietary plan and their perceived effort for

following the weight loss protocol (2006). Yet, these authors found that self-efficacy was not as strong of a predictor of more specific measures of diet and physical activity like fat consumption or flights of stairs climbed, which is similar to our findings for weight maintenance.

Some limitations to our study should be noted. The socioeconomic level of our sample was fairly high with over 58% of participants reporting an annual household income of at least $50,000, and the minimum level of education was 12 years with a sample mean of 15.3 years. These sample characteristics may limit the generalizability of our findings to individuals who are of a higher socioeconomic status. With the exception of weight, we assessed all study variables using self-report measures. Because no objective tools are currently available, the assessment of dietary intake is limited to self-report. Unfortunately, under-reporting of dietary intake has been noted (Hill & Davies, 2001; Martin, Su, Jones, Lockwood, Tritchler et al., 1996), especially in the overweight or obese (Johansson, Wikman, Ahren, Hallmans, & Johnansson, 2001; Muhlheim et al., 1998). The accuracy of the dietary assessment could also be impacted by memory, estimation of portion size, or the description of food preparation techniques (St. Jeor, 2002). Additionally, dietary intake was measured using a 3-Day Food Diary in PREFER and two 24-hour dietary recalls in PREFER II. Although both of these measures were analyzed for calorie and fat gram intake using the NDSR software, there could have been some difference in self-reported food intake. The 3-Day Food Diary is a planned recording of foods consumed and might influence eating behavior while the 24-hour dietary recall is unannounced and collects data about past behavior. Physical activity was also measured using a self-report instrument, which is susceptible to bias, imprecision, and overestimation (Prentice, 2002). Moreover, over-reporting of physical activity has been noted in persons with a higher BMI (Irwin, Ainsworth, & Conway, 2001; Jakicic, Polley, & Wing, 1998; Walsh, Hunter, Sirikul, & Gower, 2004), which could have

affected the robustness of our physical activity assessment. An objective measure of physical activity, e.g., accelerometer (Troiano, 2005), would have increased the accuracy of our assessment. While self-report is truly the only way to assess the participants' perceived barriers, experiences or confidence, using only one measurement tool may limit the inferences that can be drawn about these variables. Future investigations would benefit from using more than one tool for the self-reported assessment of variables of interest. However, this improvement in measurement precision must be balanced against participant burden.

In sum, we did not find that dietary intake and physical activity mediated the effects of psychosocial variables on weight maintenance after a behavioral weight loss trial. Yet, the findings suggest several areas of focus for weight maintenance interventions, e.g., decreasing barriers to healthy eating, increasing positive experiences with following a low-fat diet, increasing eating-related self-efficacy, and teaching individuals how to appropriately deal with stressful life events. Further research is needed to systematically identify the mechanisms or processes by which factors related to weight maintenance influence individuals' abilities to maintain their weight.

Table 6.1: Sociodemographic Characteristics (N=116)

Characteristic	***n (%)***
Gender	
Female	99 (85.0)
Male	17 (15.0)
Marital Status[a]	
Married/living with partner	79 (69.0)
Unmarried/separated	36 (31.0)
Employment[b]	
Full time	90 (78.9)
Part time	11 (9.6)
Other	13 (11.4)
Income[a]	
≤ $30,000/yr	18 (15.7)
$30-50,000/yr	30 (26.1)
≥ $50,000/yr	67 (58.2)

Characteristic	***Mean*** ***Median***	***SD***
Education (years)	15.3	2.5
(Range: 12-23)	16.0	
Age (years)	45.9	7.5
(Range: 20-55)	48.0	

Note. SD= Standard deviation; [a]One participant had missing data. [b]Two participants had missing data. [c]Three participants had missing data.

Table 6.2: Baseline, PREFER II Follow-up and % Change Variables (N=116)

	Baseline		PREFER II		% Change	
	Mean	***SD***	***Mean***	***SD***	***Mean***	***SD***
Variable	***Median***		***Median***		***Median***	
Weight (lbs)	192.5	33.2	200.6	3.8	4.46	5.8
(Range: 126.7-283.9)	191.8		197.7		4.3	
BHE[b]	51.5	15.3	55.7	14.9	12.9	29.8
(Range: 22-110)	53.0		58.5		9.1	
ELF[c]	88.3	2.6	88.1	11.5	0.9	11.8
(Range: 26-130)	87.0		87.0		0.0	
WEL[b]	120.4	35.1	113.1	33.9	1.6	41.4
(Range: 0-180)	114.0		112.5		-4.3	
Social support[c]	26.5	6.2	26.9	5.7	4.6	23.8
(Range: 7-35)	28.0		28.0		0.0	
Calorie intake[d]	1488.4	383.0	1712.1	1647.1	19.1	34.9
(Range: 630.8-3038.1)	1473.5		478.8		14.6	
Fat gram intake[d]	47.0	19.1	63.5	27.0	51.2	71.2
(Range: 13.1-154.1)	44.4		57.9		41.7	
Physical activity[b]	2997.0	2506.2	2306.5	1698.5	53.9	293.1
(Range: 0-13,979.5)	2526.0		1860.5		-22.5	
SEE		N/A	5.4	2.5		N/A
(Range: 0-10)			5.7			
Stress and eating[e]		N/A	56.4	30.0		N/A
(Range: 0-100%)			60.0			
Stress reduction[f]		N/A	39.0	28.6		N/A
(Range: 0-100%)			40.0			

Variable	*Mean* *Median*	*SD*	*Mean* *Median*	*SD*	*Mean* *Median*	*SD*
Stressful event[g]	N/A		7.1	3.0	N/A	
(Range: 0-10)			8.0			

Note. BHE= Barriers to Healthy Eating Scale; ELF= Experiences Associated with Following a Low-Fat Diet Scale; SD= Standard deviation; SEE = Self-Efficacy for Exercise; WEL= Weight Efficacy Lifestyle Scale; SEE and stress were only assessed at PREFER II; thus, percent change scores are not applicable. [a]One participant had missing data. [b]Two participants had missing data. [c]Three participants had missing data. [d]Five participants had missing data. [e]How often does stress influence how you eat? [f]How often do you use tricks to lower your stress level (deep breathing, journal writing, exercise, relaxing hobbies, time management, etc.)? [g]How much did this stressful event affect your eating habits (for the subsample of 73 who reported experiencing a stressful life event)?

Table 6.3: Univariate Models for Each Psychosocial Predictor Regressed on % Weight Change

Predictor variable	*b*	*SE (b)*	*Standardized Beta*	*t-value*	*p-value*
BHE (*N*=112)	0.09	0.02	.38	4.37	<.001
ELF (*N*=113)	-0.12	0.04	-.24	-2.62	.01
WEL (*N*=112)	-0.04	0.01	-.21	-2.27	.03
SEE (*N*=116)	<0.01	0.02	<0.01	0.02	.98
Social Support (*N*=110)	-0.02	0.03	-.07	-0.70	.49
Stress and eating[a] (*N*=115)	0.02	0.02	.12	1.23	.22
Stress reduction[b] (*N*=114)	-0.03	0.02	-.18	-1.93	.06
Stressful event[c] (*n*=73)	0.47	0.22	.25	2.14	.03

*Note. N*s vary due to missing data and deletion of influential outliers except for stressful event. BHE= Barriers to Healthy Eating Scale; ELF= Experiences Associated with Following a Low-Fat Diet Scale; SE= Standard error; SEE= Self-Efficacy for Exercise Scale; WEL= Weight Efficacy Lifestyle Scale. [a]How often does stress influence how you eat? [b]How often do you use tricks to lower your stress level (deep breathing, journal writing, exercise, relaxing hobbies, time management, etc.)? [c]How much did this stressful event affect your eating habits (for the subsample of 73 who reported experiencing a stressful life event)?

Table 6.4: Psychosocial Predictors Regressed on Potential Mediators

Psychosocial variables predicting calorie intake	***b***	***SE (b)***	***Standardized Beta***	***t-value***	***p-value***
BHE (*N*=109)	<0.01	<0.01	.06	.61	.54
ELF (*N* =109)	.01	.01	.08	.44	.40
WEL (*N* =109)	<0.01	<0.01	<0.01	-.06	.95
Stressful event[a] (*n*=69)	-.05	.06	-.10	-.84	.40
Psychosocial variables predicting fat gram intake	***b***	***SE (b)***	***Standardized Beta***	***t-value***	***p-value***
BHE (*N* =109)	.02	.01	.19	2.00	.04
ELF (*N* =109)	.01	.02	.04	.43	.67
WEL (*N* =109)	<0.01	<0.01	-.02	-.24	.81
Stressful event[a] (*n*=69)	-.09	.12	-.09	-.79	.43
Psychosocial variables predicting physical activity	***b***	***SE (b)***	***Standardized Beta***	***t-value***	***p-value***
BHE (*N* =111)	<0.01	<0.01	-.10	-1.07	.29
ELF (*N* =112)	<0.01	<0.01	<0.01	.03	.98
WEL (*N* =111)	<0.01	<0.01	.15	1.62	.11
Stressful event[a] (*n*=72)	-.03	.02	-.23	-1.94	.06

*Note. N*s vary due to missing data and deletion of influential outliers. Calorie and fat gram intake transformed using a square root transformation. Physical activity transformed using log base 10. BHE= Barriers to Healthy Eating Scale; ELF= Experiences Associated with Following a Low-Fat Diet Scale; SE= Standard error; WEL= Weight Efficacy Lifestyle Scale. [a]How much did this stressful event affect your eating habits (for the subsample of 73 who reported experiencing a stressful life event)?

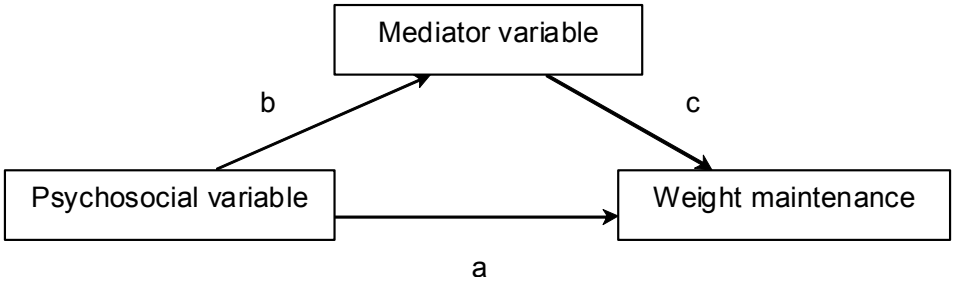

Figure 6.1: Illustration of statistical mediation examined in PREFER II

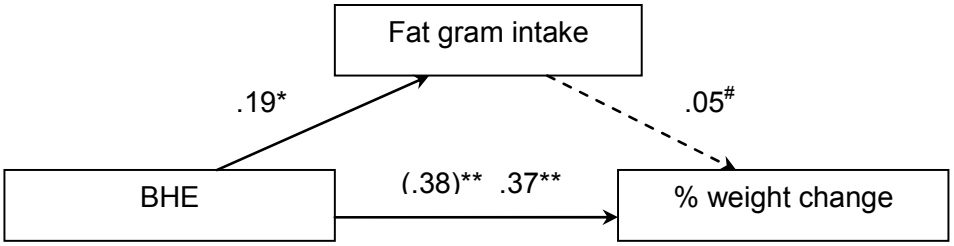

Figure 6.2: Model of relationships among Barriers to Healthy Eating (BHE), fat gram intake, and % weight change.

Values shown are standardized regression coefficients. The value in parentheses reflects the coefficient for the direct effect without fat gram intake in the model. **p*< .05; ***p*< .001; #*p*= .58.

APPENDIX A

PUBLISHED PRELIMINARY STUDY

Changes in Self-Effifcacy and Dietary Adherence: The Impact on Weight Loss in the PREFER Study

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Changes in self-efficacy and dietary adherence: the impact on weight loss in the PREFER study

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Abstract Findings from studies examining self-efficacy and its relationship to weight loss have been inconsistent. We examined self-efficacy specific to changing eating behaviors in the PREFER trial, an 18-month behavioral weight-loss study, to determine if self-efficacy and dietary adherence were associated with weight change, and what impact self-efficacy had on weight change after controlling for adherence. Measurements included the weight efficacy lifestyle (WEL) questionnaire, body weight, self-reported fat gram intake, kilocalorie intake, and adherence to kilocalorie and fat gram goals at baseline, 6, 12, and 18 months. The sample ($N = 170$) was 88.2% female and 70.0% Caucasian; the mean age was 44.1 years (SD = 8.8). Mean weight loss at 18 months was 4.64% (SD = 6.24) of baseline body weight and the mean increase in self-efficacy was 11.70% (SD = 38.61). Self-efficacy improved significantly over time ($p = 0.04$) and was associated with weight loss ($p = 0.02$). Adherence to the fat gram goal was associated with weight loss ($p = 0.0003$), and self-efficacy remained associated with weight loss after controlling for fat gram adherence ($p = 0.0001$). Consistent with self-efficacy theory, improvement in self-efficacy over time supported greater weight loss. Adherence to the fat gram goal also influenced weight loss.

Keywords Weight loss · Self-efficacy · Adherence · Vegetarian diet · Obesity

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Introduction

Obesity is a pervasive, chronic public health problem associated with multiple co-morbid conditions (Klein et al. 2004; Mokdad et al. 2003). Recommendations for overweight and obese individuals include losing and maintaining a loss of 5–10% of initial body weight in order to reduce the risk of developing chronic disorders such as coronary heart disease, hypertension, hyperlipidemia, and type 2 diabetes (Klein et al. 2004; Jakicic et al. 2001). Despite initial successes in weight-loss programs, the prevention of weight regain has remained a challenge (Jeffery et al. 2000). Typically, approximately a third of the weight an individual loses is regained within the first year after treatment (Wadden and Phelan 2002) and, at times, weight gain continues beyond the person's original pre-treatment weight. Assisting individuals in their efforts to continue behaviors that promoted the initial weight loss is a crucial concern for the health care community.

Weight-loss therapy can include the use of a limited number of available medications, surgical interventions for morbid obesity, and most commonly cognitive behavioral therapy. Also known as standard behavioral therapy, this treatment approach incorporates instruction and counseling in modifying behaviors, changing dietary intake to reduce the number of calories and amount of fat consumed, and increasing physical activity (Wing 1998). Adherence to the weight-loss treatment protocol, such as consuming the

prescribed amount of calories and fat grams, becomes a critical component of success. In fact, continued adherence to the prescribed diet has been found to be essential to weight loss success, regardless of the type of diet (Dansinger et al. 2005). A recent study examining the effects of a diet moderate in fat intake (30% of kilocalorie intake) compared to a diet low in fat (20% of kilocalorie intake) found that participants in the moderate-fat intake group experienced greater weight losses in the long term compared to those in the low-fat group; the authors suggested that dietary adherence in the moderate-fat intake group may have been easier to achieve and therefore resulted in more successful weight loss outcomes (Azadbakht et al. 2007). It has been proposed that allowing participants to choose their own treatment may improve adherence. Although therapeutic approaches for treating obesity have been studied for decades, providing an individual with his/her preference for weight-loss treatment is an area that has not been well researched, and results of examinations of preference for obesity treatment are mixed (Mendonca and Brehm 1983; Murray 1976; Renjilian et al. 2001). The existing literature does not include reports of the effects of both dietary adherence and self-efficacy on weight loss in the context of a clinical trial that included random assignment to receive one's preferred dietary treatment or not.

Self-efficacy, a component of social cognitive theory, is defined as an individual's judgment regarding his/her abilities to perform certain behaviors (Bandura 1997). The premise of self-efficacy is that beliefs regarding personal accomplishment or mastery (self-efficacy or efficacy expectancy) and desired outcomes (outcome expectancy) determine if persons will begin a behavior, what they will try to attain, and the degree of effort they will exert in a particular behavior (Bandura 1977). Self-efficacy describes the critical role a person's estimation of his/her capabilities plays in behavior change, and perceived self-efficacy, which is specific to certain activities, is a major determinant of performance independent of actual underlying skill (Bandura 1986). The strength of perceived self-efficacy is particularly important; individuals are more likely to continue their efforts until success is achieved if their perceived self-efficacy is higher (Bandura 1982). Four sources of self-efficacy include enactive attainment (actual performance of the task), vicarious experience (witnessing comparable people perform the task), verbal persuasion (informing a person that he/she has the ability to perform the task), and physiological feedback (physical cues to assess one's progress, e.g., less shortness of breath with stair-climbing) (Bandura 1997).

Empirical evidence is inconsistent in relating self-efficacy to weight loss. Investigators have found that higher weight-loss specific self-efficacy tends to predict more successful weight loss and maintenance (Richman et al. 2001), and increased self-efficacy has been shown to be related to behaviors associated with weight loss, e.g. increasing dietary fiber (Hagler et al. 2007; Schwarzer and Renner 2000) decreasing fat intake (Nelson et al. 2007; Schwarzer and Renner 2000; Steptoe et al. 2000), and increasing fruit and vegetable consumption (Hagler et al. 2007; Henry et al. 2006; Van Duyn et al. 2001). In particular, Linde and colleagues found that greater eating self-efficacy prospectively predicted weight-loss behaviors such as higher total days in which participants were adherent to the dietary plan, counted their caloric intake, and consumed less fat. Yet, while self-efficacy predicted weight loss during the active intervention, it was not associated with weight change during the follow-up period (Linde et al. 2006). A study of 54 obese women found that those with the highest self-efficacy beliefs and greater self-esteem at baseline lost significantly more weight at the end of the intervention than the "disbelievers." Disbelievers were those who had less confidence in their ability to manage weight and gave up more readily (Dennis and Goldberg 1996). Conversely, researchers examining 106 overweight or obese African-American women found that higher levels of self-efficacy prior to treatment were associated with less weight loss, suggesting that high initial self-efficacy might actually indicate overconfidence or inexperience with the complexities of losing weight (Martin et al. 2003). Additionally, some have found that higher self-efficacy was not related to greater weight loss among adolescents (White et al. 2004), not significantly predictive of weight loss in men (Linde et al. 2004), and not associated with treatment program completion or weight loss (Fontaine and Cheskin 1997; Martin et al. 2002). Among 2,311 participants in a Web-based weight-loss program, individuals with higher self-efficacy at baseline were less likely to attend the follow-up assessment at 12 months (Glasgow et al. 2007).

The findings regarding self-efficacy and weight loss have been conflicting; furthermore, no weight-loss studies examining self-efficacy have incorporated the effect of adherence to the dietary protocol. Therefore, the purpose of this study was to examine if (1) increases in weight-loss specific self-efficacy were associated with weight loss over time, (2) higher adherence to the dietary protocol was related to weight loss, and (3) after controlling for dietary adherence, increases in self-efficacy were associated with weight loss, among participants in an 18-month, behavioral treatment weight-loss trial. A key component of the study's cognitive behavioral therapy involved educating participants about techniques to reduce fat and kilocalorie intake along with prescribing daily kilocalorie and fat gram goals based upon initial weight; therefore, we examined the effect of changes in kilocalorie intake and fat gram intake together with changes in self-efficacy as potential correlates

of weight loss. Also, because the self-efficacy instrument that was used specifically measured confidence in the ability to resist eating, we considered it important to examine changes in eating behaviors (i.e., changes in the intake of fat grams and kilocalories) and their relativity to weight loss and self-efficacy. Dietary adherence was based upon the amount of self-reported kilocalories and fat grams consumed in proportion to the prescribed daily goal.

Methods

Design and setting

This secondary analysis examined the temporal interrelationships among weight loss, self-efficacy, and dietary adherence data from the parent study, the PREFER trial, an 18-month behavioral weight-loss treatment study that randomized participants to receive their dietary treatment preference or not as well as to one of two treatment groups: standard behavioral treatment plus a standard calorie- and fat-restricted diet (STD-D) or standard behavioral treatment plus a calorie- and fat-restricted lacto-ovo-vegetarian diet (LOV-D). A detailed description of the design and randomization scheme for the PREFER trial can be found elsewhere (Burke et al. 2006). In brief, 932 adults were screened from September 2002 to May 2004. Two hundred participants were enrolled in three cohorts, stratified on race and gender, and then randomly assigned using minimization procedures (Pocock and Simon 1975) with a computer-generated program to treatment Preference-Yes or treatment Preference-No. The project data manager and statistician devised and oversaw the two-stage randomization process. Figure 1 displays a participant flow diagram from eligibility screening to completion of the study at 18 months. Those randomized to treatment Preference-Yes were assigned to their preferred diet plan (STD-D or LOV-D). Those randomized to treatment Preference-No were then randomized again to receive either STD-D or LOV-D, without regard to their dietary preference. Written, informed consent was obtained from all participants after approval by the University of Pittsburgh Institutional Review Board.

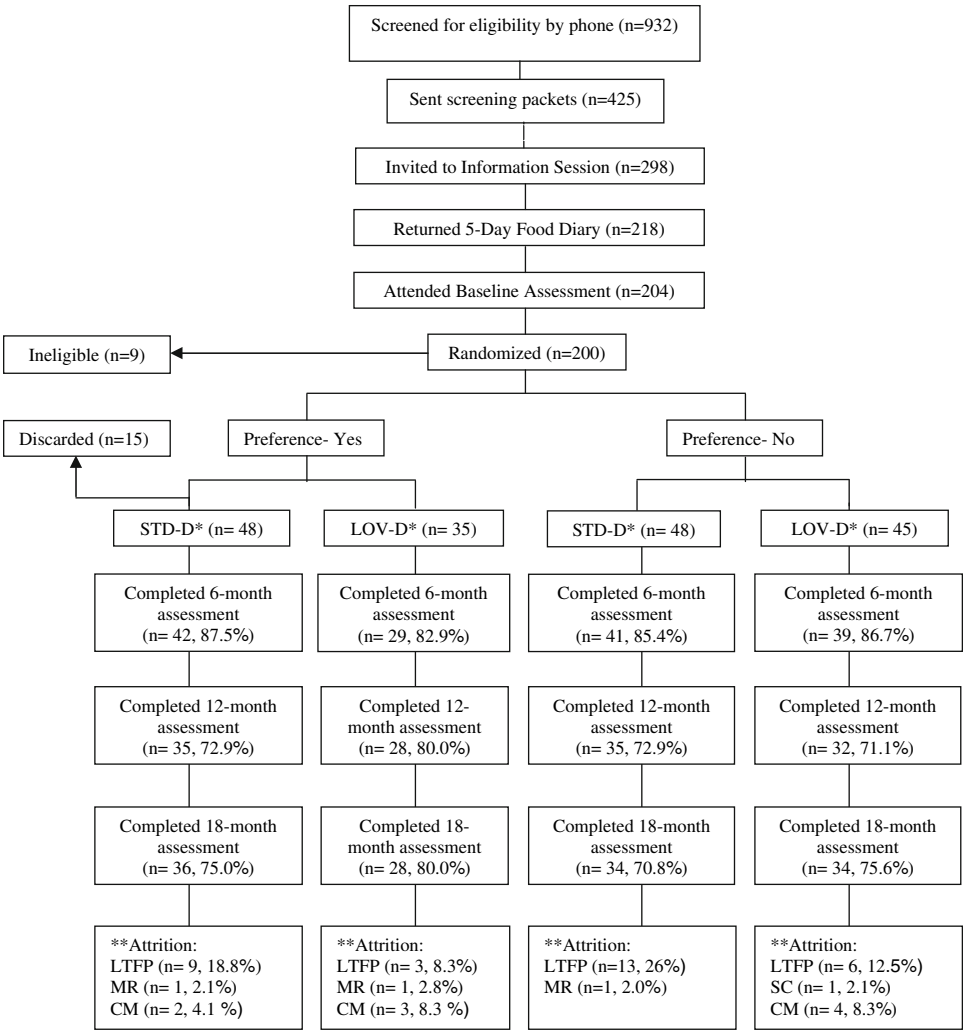
Sample

Participants were recruited from a large urban area in southwestern Pennsylvania. Eligibility criteria required that participants were 18–55 years old, agreeable to randomization to their treatment preference or not as well as to one of the two diet plans, had a body mass index (BMI) (i.e., weight in kilograms divided by height in meters squared) between 27 and 43, inclusively, and had adequately completed a 5-day food intake diary to demonstrate that they could self-monitor their food intake. The age range was chosen to ensure an adult population that was young enough to have a limited occurrence of co-morbidities, such as osteoarthritis, that might prohibit participation in physical activity. Individuals were excluded if they had a serious illness requiring medical supervision, physical restriction preventing them from exercising, were pregnant or planning a pregnancy in the next 18 months, diagnosed with a psychological illness, drank ≥4 alcoholic beverages per day, had participated in a weight-loss program in the previous 6 months, were taking weight-loss or anti-depressant medications, reported a binge eating disorder, or were currently following a vegetarian diet.

Intervention

Each treatment group received the same standard behavioral therapy and followed a calorie-restricted (1,200 kcal for women weighing <200 lbs, 1,500 kcal for women weighing ≥200 lbs, 1,500 kcal for men weighing <200 lbs, and 1,800 kcal for men weighing ≥200 lbs) and fat-restricted (25% of daily calories) diet for 18 months. The LOV-D group gradually eliminated all meat, fish, and poultry over the first 6 weeks of the study but was permitted to continue to eat dairy products, eggs, and meat flavorings. The standard behavioral treatment components of the intervention incorporated the four sources for increasing one's self-efficacy. Participants achieved enactive attainment when they lost weight and had vicarious experiences observing other group members lose weight. Interventionists and study staff provided verbal persuasion that the participant had the ability to lose weight, and participants received physiologic feedback after losing weight, for example, feeling more comfortable and experiencing less fatigue. Intervention sessions were approximately 1 h long and focused on teaching cognitive behavioral strategies for weight loss (e.g. self-monitoring food intake and physical activity, goal setting, feedback on progress and goal achievement with suggestions on how to improve, reinforcement of progress, problem solving, recipe modification, etc.). For the first 6 months, intervention sessions were held weekly, then biweekly for months 7 through 9, and monthly for months 10 through 12. A 6-month maintenance period followed and participants had no contact with the staff of the study except to arrange the 18-month assessment appointment. Body weight was measured and participant-maintained food-intake and physical activity records were submitted at each intervention session. The interventionists reviewed the diet and physical activity diaries and provided written feedback. Individuals were able to track their weight-loss progress in provided graphs, and feedback was given on physical and biological changes

Fig. 1 Participant flow diagram



*** STD-D –** Standard Diet**; LOV-D –** Lacto-Ovo-Vegetarian Diet
****LTFP** – Lost to follow up; **MR** – medical reasons; **CM** – changed mind; **SC** – schedule conflict

after the 6-, 12- and 18-month assessments. All participants were instructed to increase their physical activity gradually over the first 6 weeks, primarily through walking, with a weekly goal of 150 min of activity. Burke et al. (2006) provided a complete description of the features of the standard behavioral treatment and intervention components elsewhere.

Measures

The Weight Efficacy Lifestyle (WEL) Scale was used as the measure of self-efficacy specific to eating behaviors. Initially based on the smoking confidence questionnaire by Condiotte and Lichtenstein (1981), the 20-item questionnaire asked participants to rate their confidence in their ability to avoid eating on a 10-point Likert scale, 0 (not confident) to 9 (very confident) (Clark et al. 1991). The WEL contains five components—negative emotions ('I can resist eating when I am angry'), availability ('I can control my eating on the weekends'), social pressure ('I can resist eating even when I have to say no to others'), physical discomfort ('I can resist eating when I feel physically run down'), and positive activities ('I can resist eating when I am watching TV'). Cronbach alpha coefficients ranged from 0.70 to 0.90 (Clark et al. 1991). The external validity of the WEL was also well established in six multidisciplinary weight-loss studies (Cargill et al. 1999; Clark et al. 1996; King et al. 1996; Miller et al. 1999; Pinto et al. 1999a, b). Scores range from 0 to 180 with higher scores indicating greater levels of self-efficacy. The WEL score for each participant was derived by totaling the numerical scores from each item; the WEL subscale scores were derived by totaling the scores from the four items that comprised each subscale.

Adherence to the dietary protocol, i.e., the kilocalorie goal and fat gram goal, was determined from the Three-Day Food Record used to evaluate food intake for nutrient analysis at each 6-month assessment point. The self-reported nutrient

intake was analyzed at the Obesity/Nutrition Research Center at the University of Pittsburgh using the Nutrition Data System-Research (NDS-R) (Buzzard et al. 1995). NDS-R analyses provided a mean kilocalorie and fat gram intake for each time point. The staff entering the data was blinded to the randomization group and assessment time point. Percent adherence to the fat gram and kilocalorie goal was determined by comparing the actual intake of fat grams and kilocalories to the individually prescribed amounts for each. Adherence was calculated as the amount consumed divided by the amount prescribed multiplied by 100. For example, if a participant consumed 1,100 kcal and the daily prescription was 1,200 kcal the person would be considered 91.7% adherent. Adherence was then categorized based upon three ranges; 0–84.99% (under consumers), 85.0–114.99% (adherers), and greater than or equal to 115% (over consumers).

Baseline, 6-, 12-, and 18-month weights and self-efficacy scores were examined as outcome measures for this analysis. Weight in kilograms was measured following an overnight fast using the Tanita scale and body fat analyzer with subjects wearing light clothing and standing bare foot on the scale's footpads. Multiple psychosocial instruments were administered at each assessment. For this report, only the WEL, a measure of self-efficacy for weight loss, was examined in relation to weight change. The primary outcome measures for this analysis included percent weight change and percent change in self-efficacy over time relative to baseline values.

Statistical analysis

SPSS (Version 13, SPSS, Inc., Chicago, IL) and the SAS System for Windows (Version 9.1, SAS Institute Inc., Cary, NC) were used to analyze the data. The significance level for two-sided hypothesis testing was set at 0.05. Baseline values of descriptors and outcomes were examined for differences among the four treatment groups using chi-square and Fisher's exact tests for categorical variables and the *F*-test from an analysis of variance or a Kruskal–Wallis test for continuous variables. Missing values for longitudinal data were imputed using a combination of the last-observation-carried-forward (LOCF) and baseline value approaches. The LOCF approach for handling missing data is commonly used in clinical trials (Unnebrink and Windeler 2001) and has also been used by weight-loss researchers (Wadden et al. 2005; Toobert et al. 2005; Yeh et al. 2003; McManus et al. 2001). For 21 participants, baseline values were the last observations used for LOCF imputations because these persons were not assessed at any subsequent time points.

Linear mixed modeling via SAS PROC MIXED was used to examine correlates of weight change over time (1) changes in self-efficacy and dietary intake (kilocalories and fat grams) over time and (2) changes in self-efficacy controlling for dietary adherence (kilocalorie and fat gram adherence) over time. Change was formulated as "percent change from baseline," computed as the change from a follow-up time point to baseline standardized by the baseline value and expressed as a percentage. The "heterogeneous Toeplitz" and the "unstructured" variance–covariance structures demonstrated the best fit to the repeated measures based on information criteria in the main self-efficacy models and the adherence models, respectively. Although not of primary interest in this secondary analysis, the design variables, i.e., the randomized assignment to preference (Yes, No) and diet (STD-D, LOV-D), along with time (6, 12, 18 months), were included in all models. Initially, a mixed model was estimated with self-efficacy change as the dependent variable, including the design variables and two-way interactions as independent variables, to determine if there was a difference in changes in self-efficacy over time among the randomized groups. For the dependent variable of weight change, mixed models were built hierarchically by first examining the main effects of the design variables, their two-way interactions and the three way interaction of diet × preference × time, which was not significant. Self-efficacy change was then included as a predictor in the second block with changes in fat gram and kilocalorie intakes. The adherence models for weight change were also built in a hierarchical fashion, with the design variables entered in the first block, followed by dietary adherence variables in the second block with the change in self-efficacy entered in the last block. This allowed us to determine the effect of self-efficacy change on weight change after controlling for changes in dietary adherence. Multicollinearity between dietary intake variables and also between dietary adherence variables necessitated the fitting of mixed models considering each intake and adherence variable separately as correlates of weight change. The Sobel test was used to explore the possible mediating effects of fat gram adherence and kilocalorie adherence on weight loss at each time point (Preacher and Hayes 2004); however, there were no significant mediation effects for dietary adherence at any time point.

Model assessment supported the statistical assumptions underlying linear mixed modeling yet revealed eight multivariate outliers, six in the two main self-efficacy models with change in kilocalorie and fat gram intake and two additional outliers in the two adherence models. These outliers were assessed via sensitivity analyses and were ultimately excluded from analyses because they overly influenced the results. This set of outliers comprised 4.5% of the total sample and had a higher mean weight loss at 18 months [22.59 (SD = 5.55)%], $t(174) = -8.79$, $p < 0.001$) with a marginally greater improvement in

self-efficacy [37.02 (SD = 41.12)%], $t(174) = 1.87$, $p = 0.06$) compared to the rest of the sample. With a mean age and total years of education similar to the rest of the sample, the outliers were from all four randomization groups, consisted of three men and five women and were mostly Caucasian ($n = 7$) with one African-American. For kilocalorie adherence, the largest proportion these participants were "adherers" at 6 and 12 months and equally divided between "over consumer" and "adherers" at 18 months. The outliers were mainly "under consumers" at 6 months, "over consumers" or "under consumers" at 12 months, and "adherers" at 18 months with respect to their fat gram adherence.

Results

Table 1 summarizes the baseline demographic characteristics of the sample by randomization group. No significant demographic differences were found between the groups. Table 2 shows that there were also no baseline differences in the independent or outcome variables, all $p > 0.29$. There were no group differences, i.e., randomization, diet, or preference, among the three adherence categories for fat gram adherence or kilocalorie adherence, all $p > 0.11$. Most participants were "adherers" at 6 and 12 months and "over consumers" at 18 months for the kilocalorie goal while most were "over consumers" at all time points for the fat gram goal. See Table 3.

No significant differences between the diet groups were observed over time (i.e., no diet by time interactions) for weight, self-efficacy, kilocalorie, or fat gram change, but a significant preference by time interaction was observed for weight loss [$F(2,167) = 4.49$, $p = 0.01$] with a marginal preference by time interaction for a decrease in fat gram intake [$F(2,167) = 2.34$, $p = 0.09$]. A significant effect of preference on weight loss has been reported previously in the main outcome paper for the PREFER study (Burke et al. 2007b). Significant time effects (i.e., within group changes) were observed where fat gram intake decreased [$F(2,167) = 11.35$, $p < 0.001$] and self-efficacy increased [$F(2,167) = 3.12$, $p = 0.04$]. Table 2 shows the mean changes from baseline in weight, self-efficacy, kilocalorie and fat gram intake among the four randomization groups. Figure 2 illustrates the mean weights and WEL scores for the total sample at baseline, 6, 12, and 18 months with self-efficacy changes mirroring weight changes. As the greatest increase in self-efficacy occurred from baseline to 6 months [11.81 (SD = 28.83)], $t(169) = 5.34$, $p < 0.001$, the greatest weight loss occurred [–6.61 kg (SD = 5.55)], $t(169) = 15.54$, $p < 0.001$. Very little change occurred in self-efficacy during months 6–12

Table 1 Baseline demographic characteristics by randomization groups

	Pareference-Yes		Preference-No	
	STD-D ($n = 47$)	LOV-D ($n = 33$)	STD-D ($n = 46$)	LOV-D ($n = 44$)
Gender, *n* (%)*				
Female	42 (89.4)	26 (78.8)	42 (91.3)	40 (90.9)
Male	5 (10.6)	7 (21.2)	4 (8.7)	4 (9.1)
Race, *n* (%)**				
White	33 (70.2)	24 (72.7)	32 (69.6)	30 (68.3)
Non-white	14 (29.8)	9 (27.3)	14 (30.4)	14 (31.8)
Marital status, *n* (%)**				
Never married	10 (21.7)	6 (18.8)	9 (19.6)	8 (18.2)
Married/living with partner	27(58.7)	21 (65.6)	30 (65.2)	29 (65.9)
Divorced/separated	9 (19.6)	5 (15.6)	7 (15.2)	7 (15.9)
Employment, *n* (%)*				
Full time	39 (83.0)	27 (81.8)	38 (82.6)	35 (79.5)
Part time	4 (8.5)	2 (6.1)	4 (8.7)	3 (6.8)
Other	4 (8.5)	2 (6.1)	4 (8.7)	6 (13.6)
Age (years), *M*(SD)***	43.04 (9.46)	44.73 (8.51)	43.50 (8.72)	45.45 (8.59)
Education (years), *M*(SD)***	15.09 (2.63)	14.88 (2.40)	15.30 (2.39)	15.30 (2.72)

Note: Data are missing on two participants for marital status and employment

*Fisher's exact test (gender, $p = 0.36$; employment, $p = 0.97$)

**Pearson-chi square (race, $p = 0.97$; marital status, $p = 0.99$)

***Kruskal–Wallis (age, $p = 0.42$; education, $p = 0.84$)

Table 2 Changes from baseline in body weight, self-efficacy, kilocalorie intake, and fat gram intake

	Preference-Yes				Preference-No				*p*-Values		
	STD-D (n = 47)		LOV-D (n = 33)		STD-D (n = 46)		LOV-D (n = 44)		Pref	Time	$P \times T$
	M	SD	*M*	SD	*M*	SD	*M*	SD			
Weight, kg											
Baseline	96.6	12.6	98.3	11.8	93.5	16.6	94.9	16.7	.032	<0.001	0.012
6 months	90.5	12.8	91.2	13.5	86.8	17.9	88.1	17.4			
12 months	91.6	13.3	92.2	13.6	86.7	17.6	87.3	17.8			
18 months	93.6	13.7	95.1	12.9	88.2	17.4	89.2	17.4			
% change at 18 months	–3.0	5.2	–3.3	4.7	–5.7	6.1	–6.1	7.7			
Self-efficacy, (0–180 range)											
Baseline	105.9	31.8	105.2	36.1	106.7	32.7	117.3	34.0	.234	0.046	0.568
6 months	120.6	29.5	120.7	32.5	117.1	36.8	124.8	34.0			
12 months	117.4	29.5	116.9	36.7	117.9	36.0	124.4	35.4			
18 months	113.0	32.4	111.5	33.0	112.9	37.4	123.6	33.6			
% change at 18 months	12.6	39.2	15.3	45.5	8.0	30.6	11.9	40.7			
Kilocalories											
Baseline	1,940.5	627.5	2,124.6	801.7	2,117.3	659.0	1,973.1	605.6	0.111	0.053	0.450
6 months	1,480.7	621.1	1,619.2	641.0	1,568.5	569.2	1,401.9	317.5			
12 months	1,565.4	661.2	1,595.5	459.5	1,518.8	533.7	1,440.5	381.7			
18 months	1,578.6	637.1	1,669.6	535.5	1,542.3	520.7	1,478.7	362.1			
% change at 18 months	–15.9	28.5	–14.3	32.3	–22.6	29.0	–22.1	18.2			
Fat grams											
Baseline	75.7	31.5	83.3	36.9	86.5	35.0	77.2	30.2	0.134	<0.001	0.099
6 months	45.9	32.6	48.7	31.9	50.7	26.5	41.5	21.1			
12 months	52.4	37.1	51.7	25.1	50.3	26.3	45.1	21.7			
18 months	54.9	34.0	59.6	28.3	52.7	24.3	46.4	21.7			
% change at 18 months	–22.6	50.0	–16.7	52.7	–30.5	44.6	–35.6	26.6			

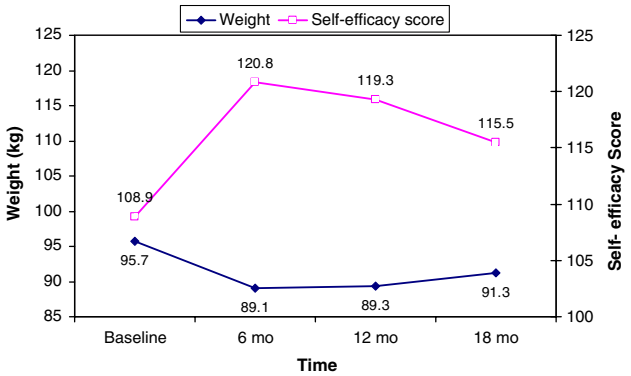
Note: No significant differences in baseline values between the randomization groups, p's > 0.29. $P \times T$: preference by time interaction. *p*-Values reflect changes over time from baseline to 18 months

Table 3 Kilocalorie and fat gram adherence categories over time (N = 170)

	6 months *n* (%)		12 months *n* (%)		18 months *n* (%)	
	Kilocalorie	Fat gram	Kilocalorie	Fat gram	Kilocalorie	Fat gram
Under consumers	38 (21.6)	56 (31.8)	34 (19.3)	41 (23.3)	33 (18.8)	32 (18.2)
Adherers	72 (40.9)	45 (25.6)	73 (41.5)	49 (27.8)	71 (40.3)	44 (25.0)
Over consumers	66 (37.5)	75 (42.6)	69 (39.2)	86 (48.9)	72 (40.9)	100 (56.8)

[–1.48 (SD = 24.02)], $t(169) = 0.80$, $p = 0.42$, and during this same time period weight loss plateaued [0.27 kg (SD = 2.84)], $t(169) = –1.24$, $p = 0.21$. In the 12- to 18-month maintenance phase, self-efficacy significantly decreased [–3.84 (SD = 24.83)], $t(169) = 2.01$, $p = 0.04$, and significant weight regain occurred [2.01 kg (SD = 3.21)], $t(169) = –8.16$, $p < 0.001$.

An examination of the main self-efficacy model, which included fat gram intake as an independent variable, revealed that the interaction of self-efficacy change and fat gram intake change was significantly associated with weight loss over time, $F(1,282) = 6.15$, $p = 0.01$, indicating that the association of self-efficacy with weight loss varies by the level of fat gram intake. To clarify this relationship, we looked at the predicted percent weight loss based on percent change in fat gram intake and self-efficacy at one standard deviation above and below the mean for a participant in the Preference-Yes, LOV-D group at 18 months. We observed no association between self-efficacy change and weight change for those with a high level of change in fat intake (1SD above the mean) and a negative association between self-efficacy change and weight



* Possible range of response for self-efficacy score is 0-180.

Fig. 2 Mean weights and self-efficacy scores over time collapsed across all groups

change for those who had a low level of change in fat intake (1SD below the mean). The preference by time interaction was significantly associated with percent weight loss in this model, $F(2,168) = 4.11$, $p = 0.02$; the Preference-No group lost [estimated mean (SE)] 2.23 (0.94)% more weight at 12 months, $t(164) = -2.38$, $p = 0.02$, and 2.60 (0.93)% more weight at 18 months, $t(173) = -2.79$, $p = 0.006$, than the Preference-Yes group. The finding that participants who were randomly assigned a diet without regard to preference lost more weight than those in the Preference-Yes group has been reported earlier by the authors (Burke et al. 2007b). The fat gram by time interaction was also associated with weight loss, $F(2,211) = 3.15$, $p = 0.04$, where decreased fat gram intake over time was related to weight loss.

In the main self-efficacy model with kilocalorie intake as an independent variable, increase in self-efficacy was associated with weight loss, $F(1,279) = 5.63$, $p = 0.02$. The preference by time interaction was significantly associated with weight loss $F(2,168) = 4.65$, $p = 0.01$; the Preference-No group again lost more weight than the Preference-Yes group as above. The interaction of decrease in kilocalorie intake and time was also highly significantly associated with weight loss in this model, $F(2,209) = 7.22$, $p = 0.009$. There was no significant interaction between change in kilocalorie intake and change in self-efficacy, $F(1,280) = 2.04$, $p = 0.15$.

The analyses of fat gram and kilocalorie adherence showed that in the first model with fat gram adherence as an independent variable, the main effect of fat gram adherence was significantly associated with weight loss [$F(2,275) = 7.98$, $p = 0.0004$] along with time [$F(2,174) = 30.54$, $p < 0.0001$]. When self-efficacy was added to the model with fat gram adherence, self-efficacy [$F(1,311) = 15.17$, $p = 0.0001$] and fat gram adherence [$F(2,275) = 8.52$, $p = 0.0003$] were both associated with weight loss. No two-way interactions were significant. Over consumers lost [estimated mean (SE)] 1.59 (0.40)% less weight than the under consumers [$t(293) = 3.95$, $p < 0.0001$] and 0.83 (0.30)% less weight than the adherers [$t(271) = 2.75$, $p = 0.006$]. The estimated mean difference in weight loss [–0.76 (0.39)%] between the under consumers and adherers was only marginal [$t(267) = -1.94$, $p = 0.054$]. In the first model that included kilocalorie adherence as an independent variable, kilocalorie adherence was not associated with weight loss, [$F(2,311) = 0.09$, $p = 0.913$]. When self-efficacy and kilocalorie adherence were included in the model together, self-efficacy was significantly associated with weight loss [$F(1,309) = 18.96$, $p < 0.0001$], but adherence to the kilocalorie goal remained non-significant [$F(2,307) = 0.27$, $p = 0.762$].

We also examined the subscales of the WEL to determine if one particular domain of weight-loss specific self-efficacy was influencing the association of self-efficacy with weight loss. Certain scales had somewhat lower scores over time, e.g., availability compared to positive activities, suggesting that individuals were more confident in their ability to resist eating in enjoyable circumstances such as watching TV or reading, compared to when food was readily available on the weekends or at a party. See Table 4. We found that all five subscales, i.e., negative emotions, availability, social pressure, physical discomfort, and positive activities, were significantly associated with weight loss over time, all p's < 0.006.

Discussion

We examined self-efficacy related to changing eating behaviors in an 18-month behavioral intervention for weight loss to determine if changes in self-efficacy were associated with weight loss over time. Additionally, we investigated the role of dietary adherence by itself and together with self-efficacy to determine the impact on weight loss of adherence alone and in combination with self-efficacy. Our findings revealed that an increase in self-efficacy was associated with weight loss even after controlling for dietary adherence. Interestingly, we found that adherence to the fat gram goal and self-efficacy were associated with weight loss, but kilocalorie adherence was not. This might be explained by the difficulties associated with self-report data where the validity is sometimes questioned (Livingstone and Black 2003). For example, the "under consumer" adherence category may have been comprised of participants who were simply not recording all the food they ate, but this is difficult to discern from self-report data. Perhaps, fat gram adherence was better captured in the Three-Day Food Records than kilocalorie adherence because, with the messages portrayed in the lay

Table 4 WEL subscales (range = 0–36): total sample mean scores over time (N = 170)

	Baseline		6 months		12 months		18 months	
	M	SD	*M*	SD	*M*	SD	*M*	SD
Negative emotions	19.0	9.9	21.5	9.5	20.9	10.1	20.1	10.0
Availability	17.0	8.6	20.2	8.5	20.0	8.8	19.2	9.1
Social pressure	22.9	8.4	25.4	8.0	25.6	8.1	24.5	8.2
Physical discomfort	25.4	7.6	27.3	7.4	26.8	7.6	26.5	7.5
Positive activities	24.9	7.3	27.4	6.6	28.8	5.9	26.5	6.9

media regarding reducing cholesterol and following a "heart-healthy" diet, participants were more sensitive to their fat gram goal and therefore more susceptible to social desirability. Additionally, reducing fat intake was emphasized in the study as a means to reduce blood cholesterol levels and to reduce caloric intake. Moreover, under reporting of energy intake is not uncommon (Martin et al. 1996; Mertz et al. 1991), especially in persons who have higher BMIs (Johansson et al. 2001). Few investigators have reported on the effect of self-reported dietary adherence on weight-loss outcomes; however, more successful weight loss has been associated with a higher level of adherence to the recording of foods consumed (Wadden et al. 2005; Burke et al. 2007a) and with sustained adherence to the assigned diet (Dansinger et al. 2005).

In order to remain true to the design of the parent study we examined the influence of the randomization variables, i.e., diet and preference, and found that preference for dietary treatment influenced weight loss but in an unanticipated way. Persons who were randomly assigned to the Preference-No group experienced greater weight losses than those who were assigned to receive their preferred diet. Similar findings regarding preference for treatment have been reported by other weight-loss researchers. Individuals who received weight maintenance guidelines differing from their preference experienced better weight maintenance than those who received their preferred guidelines (Vogels and Westerterp-Plantenga 2005), and participants who received group weight-loss therapy compared to individual therapy lost more weight even if individual therapy was their preference (Renjilian 2001).

This study provided us a unique opportunity to examine self-efficacy for eating behavior in a weight-loss study that compared two dietary approaches along with preference for treatment, in a weight-loss trial. We found no difference in changes in self-efficacy between the randomly assigned treatment groups. The groups received the same cognitive behavioral weight-loss intervention, e.g., goal setting, reinforcement strategies, and thus experienced similar weight losses and improvements in self-efficacy with participants losing nearly 5% of their baseline weight at study completion. By the end of the trial, the overall improvement in self-efficacy was 11.7%, a finding that is consistent with others who noted that self-efficacy improved during the course of treatment (Clark et al. 1991; Ash et al. 2006; Burke et al. 2004). Other evidence supports the notion that improvement in weight-loss specific self-efficacy is a correlate of weight-loss success. A study of young adults in a 12-week weight reduction program that incorporated techniques to enhance self-efficacy found that as self-efficacy increased, food choices improved and weight loss increased (Roach et al. 2003). Others have noted that self-efficacy is associated with successful weight control both in individuals who are a healthy weight and those who had been overweight in the past (Kitsantas 2000). In an Australian population-based study, self-efficacy for preventing weight gain in the future was the variable most strongly associated with BMI, after controlling for confounding variables (Ball and Crawford 2006). In our study, despite self-efficacy significantly improving overall from baseline, it did decrease after the initial peak at 6 months. This finding is consistent with others who noted a reduction in eating and exercise self-efficacy during the course of the active intervention period (Linde et al. 2006). The challenge of continuing to maintain weight-loss behaviors could have become more apparent during the 18-month study than it was at baseline. During the first 6 months, participants experienced significant weight loss, which represents performance attainment, the most powerful source of self-efficacy enhancement. This likely explains the significant increase in self-efficacy at 6 months. However, with the decreasing frequency of group sessions and submitted diaries with feedback and reinforcement from the interventionists during the second 6 months of the study, participants began to gradually regain weight and experience decreasing self-efficacy.

Our investigation has several strengths including the examination of self-efficacy in the context of a long-term weight-loss study with a 6-month, no-contact maintenance phase, good retention of participants with 76% of individuals enrolled completing the study, and a 29.3%

minority representation. We explored the impact of the different subscales of the WEL on weight loss, which has not been previously examined to our knowledge, and found that the five domains of weight-loss specific self-efficacy were all associated with weight loss. Because the sample was recruited using multiple sources from a diverse population of community-dwelling individuals, these findings could be well generalized to both women and minorities. Only 12.1% of the participants were male; therefore, the generalizability of these findings to men may be limited. Other limitations include that the investigation was a secondary data analysis, the potential unreliability of the self-reported dietary data, and the questionable sensitivity of the WEL instrument for measuring weight-loss specific self-efficacy. Because the questions ask only about resisting eating foods in various situations, the instrument may not be considered comprehensive. 'Resisting' a poor food choice is only one part of the behavior change that must occur in order to promote weight loss. The WEL questionnaire does not assess one's ability to make positive food selections, such as choosing fruits and vegetables, which support weight loss and lifestyle modification. The focus of the cognitive behavioral weight-loss intervention was directed to positive eating behaviors, e.g., the available healthy food choices, rather than on the denial of foods. Thus, this instrument may lack thoroughness in assessing self-efficacy for weight loss, and future research should measure weight-loss specific self-efficacy more comprehensively. Moreover, a multi-factorial behavior, such as weight management, includes both healthy eating and regular physical activity, and requires multiple measures of self-efficacy (Bandura 1997). Therefore, it would be important to also measure self-efficacy for exercise.

Our findings indicate that self-efficacy improved significantly, adherence to the fat gram goal was associated with weight loss, and that weight loss was significant over time. These findings suggest that enhancement in weight-loss specific self-efficacy does support successful weight loss. This cognitive behavioral intervention included specific strategies that may have increased self-efficacy for weight loss, e.g., goal setting, verbal persuasion, feedback, and reinforcement of success. Future studies should examine the effect of interventions that further support adherence to the fat gram goal and are even more explicitly designed to increase weight-loss specific self-efficacy.

Acknowledgments This Research was supported by NIH 5R01 DK 58631, NIH F31 NR 009750. The conduct of the study was also supported by the Data Management Core of the Center for Research in Chronic Disorders NIH-NINR #P30-NR03924, the Obesity and Nutrition Research Center NIH-NIDDK #DK-046204, and the General Clinical Research Center, NIH-NCRR-GCRC #5MO1-RR00056 at the University of Pittsburgh. Clinical Trials Registration: Clinical Trials.gov, NCT00330629.

References

Ash, S., Reeves, M., Bauer, J., Dover, T., Vivanti, A., Leong, C., Sullivan, T. O. M., & Capra, S. (2006). A randomised control trial comparing lifestyle groups, individual counselling and written information in the management of weight and health outcomes over 12 months. *International Journal of Obesity, 30*, 1557–1564.

Azadbakht, L., Mirmiran, P., Esmaillzadeh, A., & Azizi, F. (2007). Better dietary adherence and weight maintenance achieved by a long-term moderate-fat diet. *British Journal of Nutrition, 97*, 399–404.

Ball, K., & Crawford, D. (2006). An investigation of psychological, social and environmental correlates of obesity and weight gain in young women. *International Journal of Obesity, 30*(8), 1240–1249.

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs: Prentice Hall.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychology, 37*(2), 122–147.

Bandura, A. (1986). *Social foundations of thought & action: A social cognitive theory*. Englewood Cliffs: Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman and Company.

Burke, L. E., Choo, J., Music, E., Warziski, M., Styn, M. A., Kim, Y., & Sevick, M. A. (2006). PREFER study: A randomized clinical trial testing treatment preference and two dietary options in behavioral weight management-rationale, design and baseline characteristics. *Contemporary Clinical Trials, 27*(1), 34–48.

Burke, L. E., Sereika, S. M., Music, E., Warziski, M., Styn, M. A., & Stone, A. (2007a). Using instrumented paper diaries to document self-monitoring patterns in weight loss. *Contemporary Clinical Trials*. Advance online publication, 25 July 2007. doi: 10.1016/j.cct.2007.07.004.

Burke, L. E., Warziski, M., Styn, M. A., Music, E., Hudson, A. G., & Sereika, S. M. (2007b). A randomized clinical trial of a standard versus vegetarian diet for weight loss: The impact of treatment preference. *International Journal of Obesity*. Advance online publication, 14 August 2007. doi: 10.1038/sj.ijo.0803706.

Burke, V., Giangiulio, N., Gillam, H. F., Beilin, L. J., & Houghton, S. (2004). Changes in cognitive measures in a randomized controlled trial of a health promotion program for couples targeting diet and physical activity. *American Journal of Health Promotion, 18*(4), 300–311.

Buzzard, I., Schakel, S., & Ditter-Johnson, J. (1995). Quality control in the use of food and nutrient databases for epidemiologic studies. In *Quality and accessibility of food-related data* (pp. 241–252). Arlington, VA: AOAC International.

Cargill, B. R., Clark, M. M., Pera, V., Niaura, R. S., & Abrams, D. B. (1999). Binge eating, body image, depression, and self-efficacy in an obese clinical population. *Obesity Research, 7*(4), 379–386.

Clark, M. M., Abrams, D. B., Niaura, R. S., Eaton, C. A., & Rossi, J. S. (1991). Self-efficacy in weight management. *Journal of Consulting and Clinical Psychology, 59*, 739–744.

Clark, M. M., Cargill, B. R., Medeiros, M. L., & Pera, V. (1996). Changes in self-efficacy following obesity treatment. *Obesity Research, 4*(2), 179–181.

Condiotte, M. M., & Lichtenstein, E. (1981). Self-efficacy and relapse in smoking cessation programs. *Journal of Consulting and Clinical Psychology, 49*(5), 648–658.

Dansinger, M. L., Gleason, J. A., Griffith, J. L., Selker, H. P., & Schaefer, E. J. (2005). Comparison of the atkins, ornish, weight watchers, and zone diets for weight loss and heart disease risk reduction: A randomized trial. *JAMA, 293*(1), 43–53.

Dennis, K. E., & Goldberg, A. P. (1996). Weight control self-efficacy types and transitions affect weight-loss outcomes in obese women. *Addictive Behaviors, 21*(1), 103–116.

Fontaine, K. R., & Cheskin, L. J. (1997). Self-efficacy, attendance, and weight loss in obesity treatment. *Addictive Behaviors, 22*(4), 567–570.

Glasgow, R. E., Nelson, C. C., Kearney, K. A., Reid, R., Ritzwoller, D. P., Strecher, V. J., Couper, M. P., Green, B., & Wildenhaus, K. (2007). Reach, engagement, and retention in an Internet-based weight loss program in a multi-site randomized controlled trial. *Journal of Medicine and Internet Research, 9*(2), e11.

Hagler, A. S., Norman, G. J., Zabinski, M. F., Sallis, J. F., Calfus, K. J., & Patrick, K. (2007). Psychosocial correlates of dietary intake among overweight and obese men. *American Journal of Health Behavior, 31*(1), 3–12.

Henry, H., Reimer, K., Smith, C., & Reicks, M. (2006). Associations of decisional balance, processes of change, and self-efficacy with stages of change for increased fruit and vegetable intake among low-income, African-American monthers. *Journal of American Diet Association, 106*, 841–849.

Jakicic, J. M., Clark, K., Coleman, E., Donnelly, J. E., Foreyt, J., Melanson, E., Volek, J., & Volpe, S. L. (2001). Appropriate intervention strategies for weight loss and prevention of weight regain for adults. *Medicine and Science in Sports and Exercise, 33*(12), 2145–2156.

Jeffery, R. W., Drewnowski, A., Epstein, L. H., Stunkard, A. J., Wilson, G. T., Wing, R. R., & Hill, D. R. (2000). Long-term maintenance of weight loss: Current status. *Health Psychology, 19*(Suppl 1), 5–16.

Johansson, G., Wikman, A., Ahren, A., Hallmans, G., & Johnansson, I. (2001). Underreporting of energy intake in repeated 24-hour recalls related to gender, age, weight status, day of interview, education level, reported food intake, smoking habits and area of living. *Public Health Nutrition, 4*(4), 919–927.

King, T. K., Clark, M. M., & Pera, V. (1996). History of sexual abuse and obesity treatment outcome. *Addictive Behaviors, 21*, 283–290.

Kitsantas, A. (2000). The role of self-regulation strategies and self-efficacy perceptions in successful weight loss maintenance. *Psychology and Health, 15*, 811–820.

Klein, S., Burke, L. E., Bray, G. A., Blair, S., Allison, D. B., Pi-Sunyer, X., Hong, Y., & Eckel, R. H. (2004). Clinical implications of obesity with specific focus on cardiovascular disease. A statement for professionals from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism. *Circulation, 110*, 2952–2967.

Linde, J. A., Jeffrey, R. W., Levy, R. L., Sherwood, N. E., Utter, J., Pronk, N. P., & Boyle, R. G. (2004). Binge eating disorder, weight control self-efficacy, and depression in overweight men and women. *International Journal of Obesity, 28*, 418–425.

Linde, J. A., Rothman, A. J., Baldwin, A. S., & Jeffery, R. W. (2006). The impact of self-efficacy on behavior change and weight change among overweight participants in a weight loss trial. *Health and Psychology, 25*(3), 282–291.

Livingstone, M. B., & Black, A. E. (2003). Markers of the validity of reported energy intake. *Journal of Nutrtion, 133*(Suppl 3), 895S–920S.

Martin, C. K., O'Neil, P. M., & Binks, M. (2002). An attempt to identify predictors of treatment outcome in two comprehensive weight loss programs. *Eating Behaviors, 3*, 239–248.

Martin, L. J., Su, W., Jones, P. J., Lockwood, G. A., Tritchler, D. L., & Boyd, N. F. (1996). Comparison of energy intakes determined by food records and doubly labeled water in women participating in a dietary-intervention trial. *American Journal of Clinical Nutrition, 63*(4), 483–490.

Martin, P. D., Dutton, G. R., & Brantley, P. J. (2003). Self-efficacy as a predictor of weight change in African-American women. *Obesity Research, 12*(4), 646–651.

McManus, K., Antinoro, L., & Sacks, F. (2001). A randomized controlled trial of a moderate-fat, low-energy diet compared with a low fat, low-energy diet for weight loss in overweight adults. *International Journal of Obesity, 25*(10), 1503–1511.

Mendonca, P. J., & Brehm, S. S. (1983). Effects of choice on behavioral treatment of overweight children. *Journal of Social and Clinical Psychology, 1*(4), 343–358.

Mertz, W., Tsui, J. C., Judd, J. T., Reiser, S., Hallfrisch, J., Morris, E. R., Steele, P. D., & Lashley, E. (1991). What are people really eating? The relation between energy intake derived from estimated diet records and intake determined to maintain body weight. *American Journal of Clinical Nutrition, 54*(2), 291–295.

Miller, P. M., Watkins, J. A., Sargent, R. G., & Rickert, E. J. (1999). Self-efficacy in overweight individuals with binge eating disorder. *Obesity Research, 7*(6), 552–555.

Mokdad, A. H., Ford, E. S., Bowman, B. A., Dietz, W. H., Vinicor, F., Bales, V. S., & Marks, J. S. (2003). Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA, 289*(1), 76–79.

Murray, D. C. (1976). Preferred versus nonpreferred treatment, and self-control training versus determination raising as treatments of obesity: A pilot study. *Psychological Reports, 38*, 191–198.

Nelson, K. M., McFarland, L., & Relber, G. (2007). Factors influencing disease self-managment among veterans with diabetes and poor glycemic control. *Journal of General Internal Medicine, 22*, 442–447.

Pinto, B. M., Borrelli, B., King, T. K., Bock, B. C., Clark, M. M., Roberts, M., & Marcus, B. H. (1999a). Weight control smoking among sedentary women. *Addictive Behaviors, 24*(1), 75–86.

Pinto, B. M., Clark, M. M., Cruess, D. G., Syzmanski, L., & Pera, V. (1999b). Changes in self-efficacy and decisional balance for exercise among obese women in a weight management program. *Obesity Research, 7*(3), 288–292.

Pocock, S. J., & Simon, R. M. (1975). Sequential treatment assignment with balancing for prognostic factors in the controlled clinical trials. *Biometrics, 31*, 103–115.

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instrumentation and Computers, 36*(4), 717–731.

Renjilian, D. A., Perri, M. G., Nezu, A. M., McKelvey, W. F., Shermer, R. L., & Anton, S. D. (2001). Individual versus group therapy for obesity: Effects of matching participants to their treatment preferences. *Journal of Consulting and Clinical Psychology, 69*(4), 717–721.

Richman, R. M., Loughnan, G. T., Droulers, A. M., Steinbeck, K. S., & Caterson, I. D. (2001). Self-efficacy in relation to eating behaviour among obese and non-obese women. *International Journal of Obesity, 25*(6), 907–913.

Roach, J. B., Yadrick, M. K., Johnson, J. T., Boudreaux, L. J., Forsythe, W. A., & Billon, W. (2003). Using self-efficacy to predict weight loss among young adults. *Journal of American Diet Association, 103*(10), 1357–1359.

Schwarzer, R., & Renner, B. (2000). Social-cognitive predictors of health behavior: Action self-efficacy and coping self-efficacy. *Health and Psychology, 19*(5), 487–495.

Steptoe, A., Doherty, S., Kerry, S., Rink, E., & Hilton, S. (2000). Sociodemographic and psychological predictors of changes in dietary fat consumption in adults with high blood cholesterol following counseling in primary care. *Health and Psychology, 19*(5), 411–419.

Toobert, D. J., Strycker, L. A., Glasgow, R. E., Barrera M. Jr, & Angell, K. (2005). Effects of the mediterranean lifestyle program

on multiple risk behaviors and psychosocial outcomes among women at risk for heart disease. *Annals of Behavioral Medicne, 29*(2), 128–137.

Unnebrink, K., & Windeler, J. (2001). Intention-to-treat: Methods for dealing with missing values in clinical trials of progressively deteriorating diseases. *Statistics in Medicine, 20*(24), 3931–3946.

Van Duyn, M. A., Kristal, A. R., Dodd, K., Campbell, M. K., Subar, A. F., Stables, G., Nebeling, L., & Glanz, K. (2001). Association of awareness, intrapersonal and interpersonal factors, and stage of dietary change with fruit and vegetable consumption: A national survey. *American Journal of Health Promotion, 16*(2), 69–78.

Vogels, N., & Westerterp-Plantenga, M. S. (2005). Categorical strategies based on subject characteristics of dietary restraint and physical activity, for weight maintenance. *International Journal of Obesity, 29*, 849–857.

Wadden, T. A., Berkowitz, R. I., Womble, L. G., Sarwer, D. B., Phelan, S., Cato, R. K., Hesson, L. A., Osei, S. Y., Kaplan, R., & Stunkard, A. J. (2005). Randomized trial of lifestyle modification and pharmacotherapy for obesity. *New England Journal of Medicine, 353*(20), 2111–2120.

Wadden, T. A., & Phelan, S. (2002). Behavioral assessment of the obese patient. In T. A. Wadden, & A. J. Stunkard (Eds.), *Handbook of obesity treatment* (pp. 186–226). New York: Guilford Press.

White, M. A., Martin, P. D., Newton, R. L., Walden, H. M., York-Crowe, E. E., Gordon, S. T., Ryan, D. H., & Williamson, D. A. (2004). Mediators of weight loss in a family-based intervention presented over the internet. *Obesity Research, 12*(7), 1050–1059.

Wing, R. R. (1998). Behavioral approaches to the treatment of obesity. In G. A. Bray, C. Bourchard, & W. P. T. James (Eds.), *Handbook of obesity* (pp. 855–877). New York: Marcel Dekker.

Yeh, M. C., Rodriguez, E., Nawaz, H., Gonzalez, M., Nakamoto, D., & Katz, D. L. (2003). Technical skills for weight loss: 2-y follow-up results of a randomized trial. *International Journal of Obesity, 27*(12), 1500–1506.

APPENDIX B

IRB APPROVAL

University of Pittsburgh
Institutional Review Board

3500 Fifth Avenue
Ground Level
Pittsburgh, PA 15213
(412) 383-1480
(412) 383-1508 (fax)

MEMORANDUM

TO: Melanie T. Warziski, BSN, RN

FROM: Sue R. Beers, PhD, Vice Chair

DATE: September 27, 2007

SUBJECT: IRB #0509159: Weight Loss Maintenance: Exploring Racial Differences

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Your renewal of the above-referenced proposal has received expedited review and approval by the Institutional Review Board under 45 CFR 46.110 (4,7). This approval is for analysis of data only.

Approval Date: September 20, 2007

Renewal Date: September 28, 2008

The protocol and consent forms, along with a brief progress report must be resubmitted at least one month prior to the renewal date noted above as required by FWA00006790 (University of Pittsburgh), FWA00006735 (University of Pittsburgh Medical Center), FWA00000600 (Children's Hospital of Pittsburgh), FWA00003567 (Magee-Womens Health Corporation), FWA00003338 (University of Pittsburgh Medical Center Cancer Institute).

Please be advised that your research study may be audited periodically by the University of Pittsburgh Research Conduct and Compliance Office.

SRB:kh

APPENDIX C

QUESTIONNAIRES/INSTRUMENTS

Experiences Associated with Following a Low-fat Diet (ELF)

Barriers to Healthy Eating (BHE)

Weight Efficacy Lifestyle (WEL)

Self-Efficacy for Exercise Scale (SEE)

Behavioral Strategy Survey (BSS)

Paffenbarger Activity Questionnaire (PAQ)

Instrument Number: 3 3 4
(For internal use only)

Study ID: 0 6 0

EXPERIENCES ASSOCIATED WITH FOLLOWING A LOW-FAT DIET

Center for Research in Chronic Disorders

ID Number: | | | | | | | | | | |

Administration Date: | | / | | / | | | | |
(month) (day) (year)

(FOR STAFF USE ONLY)

Below we have listed some things which participants report are associated with following a low-fat diet. For each item, please indicate the extent to which this factor has made it difficult for you to follow your eating plan in <u>THE PAST 6 MONTHS</u>.

Since you began the weight loss eating plan in this study, do you . . . .

	Strongly Disagree				***Strongly Agree***
	1	***2***	***3***	***4***	***5***
1. Feel you are reducing your risk of heart disease?	○	○	○	○	○
2. Feel you are reducing your risk of other diseases?	○	○	○	○	○
3. Feel you are reducing your risk of coronary heart disease?	○	○	○	○	○
4. Feel better about yourself?	○	○	○	○	○
5. Have more energy?	○	○	○	○	○
6. Feel your diet is setting a good example for your family?	○	○	○	○	○
7. Feel you are improving your general health?	○	○	○	○	○
8. Exercise more?	○	○	○	○	○
9. Feel physically uncomfortable after eating high-fat foods?	○	○	○	○	○
10. Dislike the taste of fat?	○	○	○	○	○

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Since you began the weight loss eating plan in this study, do you . . . .

	Strongly Disagree 1	2	3	4	*Strongly Agree* 5
11. Spend extra time shopping for food?	○	○	○	○	○
12. Spend extra time planning your meals?	○	○	○	○	○
13. Spend extra time preparing meals?	○	○	○	○	○
14. Spend extra money on food?	○	○	○	○	○
15. Limit your choice of restaurants?	○	○	○	○	○
16. Eat in restaurants less often?	○	○	○	○	○
17. Have difficulty maintaining a low-fat diet while traveling?	○	○	○	○	○
18. Have cravings for some of your favorite high-fat foods?	○	○	○	○	○
19. Find eating less satisfying?	○	○	○	○	○
20. Feel deprived when you cannot eat rich desserts?	○	○	○	○	○
21. Feel deprived if you eat a low-fat meal in a restaurant?	○	○	○	○	○
22. Find eating more satisfying?	○	○	○	○	○
23. Feel you are bothering your family sometimes?	○	○	○	○	○
24. Find that family members complain about the low-fat diet?	○	○	○	○	○
25. Sometimes prepare separate meals for yourself and other family members?	○	○	○	○	○
26. Find that your spouse/family discourages you from staying on a low-fat diet?	○	○	○	○	○

Instrument Number: 336
(For internal use only)

Study ID: 060

BARRIERS TO HEALTHY EATING

Center for Research in Chronic Disorders

ID Number: | | | | | | | | | | |

Administration Date: ___ (month) / ___ (day) / ___ (year)

(FOR STAFF USE ONLY)

Below we have listed some things which participants report can make it difficult to change their eating habits. For each item, please indicate the extent to which this factor has made it difficult for you to follow appropriate eating habits in <u>THE PAST 6 MONTHS</u>.

	Not at all a problem for me 1	2	3	4	*A very important problem for me* 5
1. Appropriate foods are not available in my home.	○	○	○	○	○
2. My family does not support my efforts to change my diet.	○	○	○	○	○
3. I have trouble estimating appropriate portion sizes.	○	○	○	○	○
4. It is difficult to motivate myself to eat appropriately.	○	○	○	○	○
5. I use food as a reward or treat for myself.	○	○	○	○	○
6. It is difficult to find time to plan appropriate meals for myself.	○	○	○	○	○
7. I don't see any benefits from my efforts to lose weight.	○	○	○	○	○
8. It is difficult to shop for one person in the grocery store.	○	○	○	○	○
9. I don't know what foods I should eat to lose weight.	○	○	○	○	○
10. I have difficulty controlling my eating when I am with friends.	○	○	○	○	○

	Not at all a problem for me				*A very important problem for me*
	1	*2*	*3*	*4*	*5*
11. When I am very hungry I have trouble controlling what I eat.	○	○	○	○	○
12. Losing weight is rewarding but I have trouble staying motivated to keep off the weight I lost.	○	○	○	○	○
13. Changing my diet to reduce calories and fat seems too complicated.	○	○	○	○	○
14. I feel deprived when I have to restrict so many foods.	○	○	○	○	○
15. I find it difficult to select the appropriate foods when shopping.	○	○	○	○	○
16. I never feel that my appetite is satisfied when I am trying to lose weight.	○	○	○	○	○
17. The foods that are reduced in fat and calories cost more than I can afford.	○	○	○	○	○
18. The taste of low-fat / low-calorie foods is different.	○	○	○	○	○
19. Resisting tempting high fat / high calorie foods in my work setting is difficult.	○	○	○	○	○
20. When I am busy or feeling overwhelmed, I find it difficult to remember all the rules about what foods are appropriate.	○	○	○	○	○
21. When I am with my family I find it difficult to watch what I eat.	○	○	○	○	○
22. My friends do not support me when I try to change my eating.	○	○	○	○	○

Instrument Number: 353
(For internal use only)

Study ID: 054

WEL

Center for Research in Chronic Disorders

ID Number: | | | | | | | | | | |

Administration Date: ___ (month) / ___ (day) / ___ (year)

Visit Number: 0 Baseline ○ 1 6 months ○ 2 12 months ○ 3 18 months ○

(FOR STAFF USE ONLY)

Please use the following example to answer all questions:

Shade circles like this: ●
Not like this: ⊗ ✓

This form describes some typical eating situations. Everyone has situations which make it very hard for them to manage their weight. The following pages contain a number of situations relating to eating patterns and attitudes.

Please read each situation listed below and decide how confident (or certain) you are that you will be able to resist eating in each of the difficult situations. On a scale from 0 ("Not Confident") to 9 ("Very Confident") choose ONE number that reflects how confident you feel now about being able to successfully resist the desire to eat. Fill in the circle below the number that you have chosen for your answer.

I am confident that . . . .

	Not Confident At All									***Very Confident***
	0	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***
1. I can resist eating when I am anxious (or nervous).	○	○	○	○	○	○	○	○	○	○
2. I can control my eating on the weekends.	○	○	○	○	○	○	○	○	○	○
3. I can resist eating even when I have to say "no" to others.	○	○	○	○	○	○	○	○	○	○
4. I can resist eating when I feel physically run down.	○	○	○	○	○	○	○	○	○	○
5. I can resist eating when I am watching TV.	○	○	○	○	○	○	○	○	○	○

I am confident that . . . .

	Not Confident At All									***Very Confident***
	0	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***
6. I can resist eating when I am depressed (or down).	○	○	○	○	○	○	○	○	○	○
7. I can resist eating when there are many different kinds of food available.	○	○	○	○	○	○	○	○	○	○
8. I can resist eating even when I feel it's impolite to refuse a second helping.	○	○	○	○	○	○	○	○	○	○
9. I can resist eating even when I have a headache.	○	○	○	○	○	○	○	○	○	○
10. I can resist eating when I am reading.	○	○	○	○	○	○	○	○	○	○
11. I can resist eating when I am angry (or irritable).	○	○	○	○	○	○	○	○	○	○
12. I can resist eating even when I am at a party.	○	○	○	○	○	○	○	○	○	○
13. I can resist eating even when others are pressuring me to eat.	○	○	○	○	○	○	○	○	○	○
14. I can resist eating when I am in pain.	○	○	○	○	○	○	○	○	○	○
15. I can resist eating just before going to bed.	○	○	○	○	○	○	○	○	○	○
16. I can resist eating when I have experienced failure.	○	○	○	○	○	○	○	○	○	○
17. I can resist eating even when high calorie foods are available.	○	○	○	○	○	○	○	○	○	○
18. I can resist eating even when I think others will be upset if I don't eat.	○	○	○	○	○	○	○	○	○	○
19. I can resist eating when I feel uncomfortable.	○	○	○	○	○	○	○	○	○	○
20. I can resist eating when I am happy.	○	○	○	○	○	○	○	○	○	○

Instrument Number: 778
(For internal use only)

Shade circles like this: ●
Not like this: ⊗ ✓

Study ID: 113

SELF-EFFICACY FOR EXERCISE SCALE

Center for Research in Chronic Disorders

ID Number: | | | | | | | | | | |

Administration Date: ___ (month) / ___ (day) / ___ (year)

(FOR STAFF USE ONLY)

How confident are you right now that you could exercise three times per week for 20 minutes if:

	Not Confident 0	1	2	3	4	5	6	7	8	9	Very Confident 10
1. the weather was bothering you?	○	○	○	○	○	○	○	○	○	○	○
2. you were bored by the program or activity?	○	○	○	○	○	○	○	○	○	○	○
3. you felt pain when exercising?	○	○	○	○	○	○	○	○	○	○	○
4. you had to exercise alone?	○	○	○	○	○	○	○	○	○	○	○
5. you did not enjoy it?	○	○	○	○	○	○	○	○	○	○	○
6. you were too busy with other activities?	○	○	○	○	○	○	○	○	○	○	○
7. you felt tired?	○	○	○	○	○	○	○	○	○	○	○
8. you felt stressed?	○	○	○	○	○	○	○	○	○	○	○
9. you felt depressed?	○	○	○	○	○	○	○	○	○	○	○

Instrument Number: 7 7 9
(For internal use only)

Shade circles like this: ●
Not like this: ⊗ ✓

Study ID: 1 1 3

BEHAVIORAL STRATEGY SURVEY

Center for Research in Chronic Disorders

ID Number: | | | | | | | | | | |

Administration Date: (month) / (day) / (year)

(FOR STAFF USE ONLY)

This questionnaire is asking you about strategies you learned in the PREFER Study and if they have been useful in helping you maintain your weight loss. Please complete it to the best of your ability. For each question, please estimate on the scale provided what <u>percent of the time in the last 18 months</u> you used these strategies. For example, *if you never did what is being asked -- you answer 0%. If you do it most of the time, select 80% or 90%.*

	Percent (%) of the time										
	0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1. How often did you self-monitor your food intake including total calories and total fat grams?	○	○	○	○	○	○	○	○	○	○	○
2. How often did you self-monitor your physical activity including type of activity & total minutes?	○	○	○	○	○	○	○	○	○	○	○
3. How often did you increase your daily physical activity (take the stairs, park further away, walk instead of drive)?	○	○	○	○	○	○	○	○	○	○	○
4. How often did you include scheduled physical exercise in your day?	○	○	○	○	○	○	○	○	○	○	○
5. How often did you use portion control methods (weighing your food, using references of serving size, etc.) to control your food intake?	○	○	○	○	○	○	○	○	○	○	○
6. How often did you practice being assertive with others to meet your healthy lifestyle goals (for example, reminding others of your healthy eating plan or not giving in to pressure to eat)?	○	○	○	○	○	○	○	○	○	○	○

(continued on next page)

		Percent (%) of the time										
		0	10	20	30	40	50	60	70	80	90	100
7.	How often did you read food labels while grocery shopping, looking at total calories, fat grams, and healthy claims ("reduced fat," "low-cal," "light," etc.)?	○	○	○	○	○	○	○	○	○	○	○
8.	How often did you modify your recipes when making foods (reducing or substituting high-fat or high-calorie ingredients with healthier choices)?	○	○	○	○	○	○	○	○	○	○	○
9.	How often did you handle cues (triggers) in your surroundings that may promote unhealthy choices (popcorn at the movies, snacking while watching television, high-calorie vending machines, etc.) and select a healthier choice?	○	○	○	○	○	○	○	○	○	○	○
10.	How often did you use reminders in your surroundings for doing physical activity (keep tennis shoes in sight, set an alarm to remind you to be active, make an "activity date" with a friend)?	○	○	○	○	○	○	○	○	○	○	○
11.	How often did you use problem-solving tips in situations where it is difficult to follow a healthy eating plan (for example, eating a healthy snack before a party, ordering from the light menu, packing a low-calorie lunch for work)?	○	○	○	○	○	○	○	○	○	○	○
12.	How often did you change negative thoughts you were having (excuse-making, "all or nothing" thinking, pessimism) that could interfere with your eating and physical activity plan?	○	○	○	○	○	○	○	○	○	○	○
13.	How often did you feel you had the support of family and friends for sticking to your healthy eating and physical activity lifestyle?	○	○	○	○	○	○	○	○	○	○	○
14.	How often did you use weighing yourself on a regular basis to prevent weight gain?	○	○	○	○	○	○	○	○	○	○	○
15.	How often did you use increasing physical activity to prevent weight gain?	○	○	○	○	○	○	○	○	○	○	○

16. Did you regain 2 or more pounds?

○ 1 Yes ----> **a. How often did you use your "restart plan" to prevent further weight gain?**

○ 2 No

Percent (%) of the time										
0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
○	○	○	○	○	○	○	○	○	○	○

17. Have you had a major stressful event (such as marriage, new job, divorce, death in family) in the last 18 months?

○ 1 Yes ----> **a. Please describe:** _____

_____

_____

○ 2 No

(for office use only) | | | |

b. How much did this stressful event affect your eating habits?

Using the following scale of 0-10, where 0 means "No effect" and 10 means the "Most effect" it could have, fill in the circle that corresponds to your answer:

No effect ***Most effect***

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
○	○	○	○	○	○	○	○	○	○	○

	Percent (%) of the time										
	0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
18. How often does stress influence how you eat?	○	○	○	○	○	○	○	○	○	○	○
19. How often did you use tricks to lower your stress level (deep breathing, journal writing, exercise, relaxing hobbies, time management, etc.)?	○	○	○	○	○	○	○	○	○	○	○

Instrument Number: 4 1 1
(For internal use only)

Study ID: 0 5 4

PAFFENBARGER
PHYSICAL ACTIVITY QUESTIONNAIRE

Center for Research in Chronic Disorders

ID Number: | | | | | | | | | | |

Administration Date: (month) / (day) / (year)

Visit Number: 0 ○ Baseline 1 ○ 6 months 2 ○ 12 months 3 ○ 18 months

Administration Time: (hr) : (min)

(FOR STAFF USE ONLY)

Please keep these rules in mind when responding to the questions....

Shade circles like this: ●
Not like this: ⊗ ✓

For optimum accuracy, it is recommended that characters be written block style without touching the sides of the blocks, such as in the following examples. Place only one letter or one number in each box as shown....

0	1	2	3	4	5	6	7	8	9

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

Instructions: The following questions relate to your usual physical activities for the past week. Please answer every question by marking the answer as indicated.

1. How many city blocks or their equivalent do you normally walk each day? (Let 12 blocks = 1 mile) | | . | | (blocks/day)

2. What is your usual pace of walking? (Choose only one response.)

   ○ 1 Casual or strolling (less than 2 mph)

   ○ 2 Average or normal (2-3 mph)

   ○ 3 Fairly brisk (3-4 mph)

   ○ 4 Brisk or striding (4 mph or faster)

3. How many flights of stairs do you climb up each day? (Let 1 flight = 10 steps) ☐☐ (flights/day)

4. List any sports or recreation you have actively participated in during the past week. Please include only the time you were physically active (example: actual time in walking, swimming, gardening, etc.):

Sport, Recreation, or Other Physical Activity	Number of times/week	(Average time per episode) Hours	Minutes
a.)			
b.)			
c.)			
d.)			
e.)			

(For office use only)

(Total Minutes)	(Activity Code)
	.
	.
	.
	.
	.

5. Which of these statements best expresses your view? (Choose only one response.)

○ 1 I exercise enough to keep healthy

○ 2 I ought to exercise more

○ 3 Don't know

6. At least once a week, do you engage in regular activity akin to brisk walking, jogging, bicycling, swimming, etc., long enough to work up a sweat, get your heart pumping, or get out of breath?

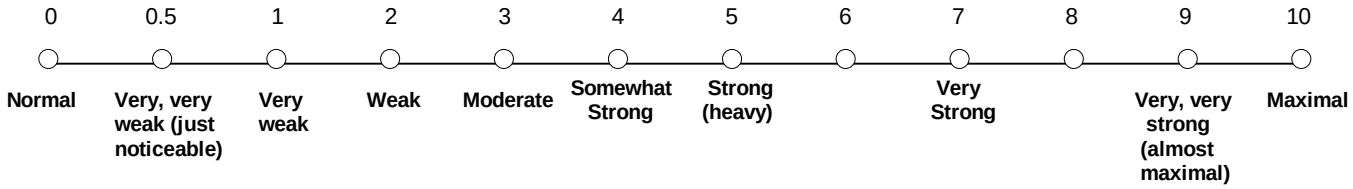
○ 1 Yes ----> List activity:_____ How many times per week? ☐☐

○ 2 No ------> Why not:_____

(For office use only)

(Activity Code) ☐☐ . ☐

7. When you are exercising in your usual fashion, how would you describe your level of exertion (degree of effort)? (Please fill in one circle only.)



8. On a usual weekday and a weekend day, how much time do you spend on the following activities? (Pick any weekday and record the number of hours you spend on **any** or **all** of the activity categories listed, "a" through "e," below. Write in the number of hours or minutes you spend on that activity category. Do the same for the weekend; pick either Saturday or Sunday and record the number of hours or minutes you spend on **any** or **all** of the activity categories. The number of total hours for each day should equal 24 hours.)

	Usual WEEKDAY Hours/day	**Usual WEEKEND Hours/day**	
a.) **Vigorous activity** (digging in the garden, strenuous sports, jogging, aerobic dancing, brisk walking, sustained swimming, heavy carpentry, bicycling on hills, etc.)			(For office use only) (Total Minutes) (Total Minutes) (For office use only) (Activity Code) .
b.) **Moderate activity** (housework, light sports, regular walking, golf, yard work, lawn mowing, painting, repairing, light carpentry, ballroom dancing, bicycling on level ground, etc.)			(For office use only) (Total Minutes) (Total Minutes) (For office use only) (Activity Code) .
c.) **Light activity** (office work, driving car, strolling, personal care, standing with little motion, etc.)			(For office use only) (Total Minutes) (Total Minutes) (For office use only) (Activity Code) .
d.) **Sitting activity** (eating, reading, desk work, watching TV, listening to radio, etc.)			(For office use only) (Total Minutes) (Total Minutes) (For office use only) (Activity Code) .
e.) **Sleeping or reclining**			(For office use only) (Total Minutes) (Total Minutes) (For office use only) (Activity Code) .

APPENDIX D

CONSENT FORM

University of Pittsburgh
Institutional Review Board
Current Approval Date: September 29, 2006
Modification Approval Date: December 7, 2006
Renewal Date: September 28, 2008
IRB # 0509159

University of Pittsburgh

School of Nursing

3500 Victoria Street
Pittsburgh, Pennsylvania 15261
Fax: 412-624-2401

CONSENT TO ACT AS A SUBJECT IN A RESEARCH STUDY

TITLE:	Weight Loss Maintenance: Exploring Racial Differences
PRINCIPAL INVESTIGATOR:	Melanie T. Warziski, RN, BSN Doctoral Student, Graduate Student Researcher 415 Victoria Building, Pittsburgh, PA 15261 Phone: (412) 624-2229
CO-INVESTIGATORS:	Lora E. Burke, PhD, MPH, RN Associate Professor of Nursing and Epidemiology 415 Victoria Building, Pittsburgh, PA 15261 Phone: (412) 624- 2305 Linda J. Ewing, PhD, RN Assistant Professor of Psychiatry and Psychology Western Psychiatric Institute and Clinic 3811 O'Hara St., Pittsburgh, PA 15213 Phone: (412) 647-3089 Susan M. Sereika, PhD Associate Professor, Nursing, Biostatistics, & Epidemiology 360 Victoria Building, Pittsburgh, PA 15261 Phone: (412) 624-0977 Stephen B. Thomas, PhD Director, Center for Minority Health 125 Parran Hall, Pittsburgh, PA 15261 (412) 624-5665
SOURCE OF SUPPORT:	National Institutes of Health, NIN

Subject's Initials _____

What is informed consent?
The information that follows describes the objective, procedures, risks, benefits, restrictions, and requirements of this research study. Your signature on this form indicates that the study has been explained to you, and that you agree to participate in the study. Informed consent is the process of reading, reviewing, and signing this form.

Why is this research being done?
People have difficulty keeping their weight off after they lose weight. The purpose of this study is to look at how people do with managing their weight 1.5 years after being in a weight loss study, and to find out if there are differences in weight management between minorities and non-minorities. In order to better understand the experiences that people have after a weight loss study, we are asking you to participate in this study. Your participation in this study will help to increase our understanding of the factors involved in weight management.

Who is being asked to take part in this study?
Individuals who completed the last assessment appointment of the PREFER study are being asked to participate in this study.

What procedures will be performed for research purposes?
If you agree to take part in this research study, you will be asked to come to the School of Nursing at the University of Pittsburgh only once at 1.5 years after you have finished the PREFER study. You will be asked to fill out some questionnaires that you completed during the PREFER study, 2 new questionnaires, and have your weight and body fat measured. If you are unable to come into Oakland, we can discuss alternative means to obtain your weight. Someone will also telephone you on 2 occasions to ask you to recall what foods you ate in the last 24 hours.

What are the possible risks and discomforts of this study?
The risks of participating in this study are very small. The primary risk from this study is the mental discomfort some people may feel when they reveal private information about themselves. Revealing of personal information may occur on questionnaire or when being weighed. To lessen this discomfort, the questionnaires being used are standard questionnaires that are commonly used in research and clinical practice and we will weigh you in a private room. No procedure with any risks is being conducted and no other possible physical or mental risks are anticipated. It is possible that the confidentiality of your information may be breached, but every possible effort will be made to protect your personal information. All information will be identified with an ID number only and will be stored in a locked file cabinet.

What are the possible benefits from taking part in this study?
There will be no specific benefit to you personally for taking part in this research study, but other people trying to maintain their weight loss may benefit from what we learn from this study.

Will I be charged for any procedures performed as a part of this research study?
You will not be billed for any research procedures that are a part of this study. A postage paid envelope will be provided to you to return all the questionnaires to the Principal Investigator.

Who will pay if I am injured as a result of taking part in this study?
Emergency medical treatment will be provided for injuries solely and directly related to your participation in this research study by the hospitals of the University of Pittsburgh Medical Center in the unlikely event that you are injured during this study. If you believe that you are injured as a result of the research procedures being performed, please immediately contact the Principal Investigator or one of the co-investigators listed on the first page of this form. You will not receive any monetary payment for, or related to, any injury you experience in relation to this study.

Will I be paid if I take part in this study?
You will receive a $25 gift certificate to Giant Eagle grocery stores after completing the questionnaires, two 24-hour dietary recalls, and weight and body fat measurement.

Will anyone know that I am taking part in this research study?
Any information about you obtained from this study will be kept as confidential (private) as possible. All records related to your participation in this study will be stored in a locked file cabinet. You will be identified on these records by a study ID number rather than your name, and the information linking these ID numbers with your identity will be kept separate from the research records.

You will not be identified by name in any paper or publication of the research results unless you sign a separate form giving your permission (release). In a rare situation, your records may be released in response to an order from a court of law. If the researchers discover that that you or someone with whom you are involved is in serious danger or harm, they will need to inform the appropriate agencies as required by Pennsylvania law. Authorized persons from the study sponsor (National Institutes of Health, NINR) and/or the University Research Conduct and Compliance Office may possibly examine your research records.

Only the researchers listed on the first page of this from and their staff will be able to gain access to you records. All information about your involvement in this study- including answers to questionnaires- will be handled in a confidential way, consistent with other hospital medical records.

How can I get more information about this research study?
You may contact the Principal Investigator, Melanie Warziski, at (412) 624-2229. If you have any questions about your rights as a research participant, please contact the Human Subject Protection Advocate of the IRB office at 1-866-212-2668.

Is my participation in this research study voluntary?
Yes. Your participation in this study is completely voluntary. You may choose not to take part in this study or you may stop participating at any time during the study, even after you have signed this form. Whether or not you give your consent to participate in this study will have no impact on your current or future relationship with the University of Pittsburgh or the UPMC Health System.

Subject's Initials _____

May I withdraw my consent for participation in this study at a future date?
You may withdraw your consent for participation in this study at any time. To formally withdraw your consent to participate in this study, you should send a written and dated notification of this decision to the Principal Investigator of this study at the address listed on the first page of this form. Any identifiable research information recorded from your participation in this study before the date that you formally withdrew your consent may continue to be used by the investigators for the research purposes described above.
****

VOLUNTARY CONSENT

I have read and reviewed the consent form for this research study. All of the above has been explained to me and all of my questions have been answered. I understand that I am encouraged to ask questions about any aspect of this research study during the course of this study, and that such future questions will be answered by the researchers listed on the first page of this form.

I understand that my participation in this study is voluntary and that I may refuse to participate or withdraw my consent and stop taking part in this study at any time.

Any questions that I have about my rights as a research participant will be answered by the Human Subjects Protection Advocate of the IRB Office, University of Pittsburgh (1-866-212- 2668).

By signing this form, I agree to participate in this research study. I will receive a copy of this consent form.

_____ _____
Participant's Signature Date and Time

_____
Printed Name of Participant

CERTIFICATION OF INFORMED CONSENT
I certify that I have explained the nature and purpose of this research study to the above-named individual, and I have discussed the potential benefits and possible risks of study participation. Any questions the individual has about this study have been answered, and we will always be available to answer any future questions.

_____ _____
Printed Name of Person Obtaining Consent Role in Research Study

_____ _____
Signature of Person Obtaining Consent Date and Time

Subject's Initials _____

APPENDIX E

RECRUITMENT LETTER

University of Pittsburgh

School of Nursing

3500 Victoria Street
Pittsburgh, Pennsylvania 15261
Fax: 412-624-2401

Dear XXXX,

We hope this letter finds you well and keeping warm during these winter months. We are writing to ask you to help Melanie Warziski, a doctoral student in the School of Nursing, complete her dissertation study. Melanie has worked on the PREFER study for over two years and is interested in learning how people manage their weight after they have completed a weight loss study, especially more about what works and does not work. Thus, it is important for Melanie to get information from *all* of you, whether you have kept off the weight or if you have gained the weight back.

For this small study, you will need to come to the School of Nursing one time to have your weight measured. If you are unable to come into Oakland, we can discuss alternative means of obtaining your weight. You will also need to complete 6 short questionnaires. The questionnaires will take you about 20 minutes to complete. You will **NOT** need to complete the Three-Day Food Diary. Instead, Melanie will call you twice and ask you what you ate in the past 24 hours. There is **NO** fasting and **NO** blood draw in this study.

To thank you for your time, we will give you a $25 gift certificate to the Giant Eagle grocery store once you have completed the study. We will pay for your parking, or if you take the bus, we will give you a bus ticket.

If you are interested in participating and helping Melanie complete her study, please call Melanie at (412) 624-2229. She will review the enclosed consent form with you and you may return it in the envelope provided.

We sincerely appreciate you taking the time to consider this request.

Sincerely,

Lora E. Burke, PhD, MPH, FAAN
Principal Investigator, PREFER Study

Melanie Warziski, BSN, RN
Doctoral Student

APPENDIX F

HUMAN SUBJECTS TRAINING MODULES

University of Pittsburgh

This is to acknowledge that

Melanie T Warziski

Completed the RPF Module

Human Subjects Research

Date of Completion: 2003-11-10

CertificateID:14856-36174

University of Pittsburgh

This is to acknowledge that

Melanie T Warziski

Completed the RPF Module

Privacy Requirements for Researchers under HIPAA

Date of Completion: 2003-11-19

CertificateID:14856-36177

University of Pittsburgh

This is to acknowledge that

Melanie T Warziski

Completed the RPF Module

Research Integrity

Date of Completion: 2003-12-07

CertificateID:14856-36828

University of Pittsburgh

This is to acknowledge that

Melanie T Warziski

Completed the RPF Module

UPMC HIPAA Security Awareness Training for Staff

Date of Completion: 2005-03-17

CertificateID:14856-54546

BIBLIOGRAPHY

Adams, J. P., & Murphy, P. G. (2000). Obesity in anaesthesia and intensive care. *British Journal of Anaesthesia, 85*(1), 91-108.

Agras, W. S., Berkowitz, R. I., Arnow, B. A., Telch, C. F., Marnell, M., Henderson, J., et al. (1996). Maintenance following a very-low-calorie diet. *Journal of Consulting & Clinical Psychology, 64*(3), 610-613.

Ainsworth, B. E., Haskell, W. L., Leon, A. S., Jacobs, D. R., Montoye, H. J., Sallis, J. F., et al. (1993). Compendium of physical activities: Classification of energy costs of human physical activities. *Medicine and Science in Sports and Exercise, 25*(1), 71-80.

Airhihenbuwa, C. O., Kumanyika, S., Agurs, T. D., Lowe, A., Saunders, D., & Morssink, C. B. (1996). Cultural aspects of African American eating patterns. *Ethnicity & Health, 1*(3), 245-260.

Allison, D. B., Fontaine, K. R., Heshka, S., Mentore, J. L., & Heymsfield, S. B. (2001). Alternative treatments for weight loss: a critical review. *Critical Reviews in Food Science & Nutrition, 41*(1), 1-28.

Allison, D. B., Kreibich, K., Heshka, S., & Heymsfield, S. B. (1995). A randomised placebo-controlled clinical trial of an acupressure device for weight loss. *International Journal of Obesity, 19*(9), 653-658.

Andajani-Sutjahjo, S., Ball, K., Warren, N., Inglis, V., & Crawford, D. (2004). Perceived personal, social and environmental barriers to weight maintenance among young women: A community survey. *International Journal of Behavioral Nutrition and Physical Activity, 1*(1), 15-21.

Andersen, L. F., Jacobs, D. R., Jr., Carlsen, M. H., & Blomhoff, R. (2006). Consumption of coffee is associated with reduced risk of death attributed to inflammatory and cardiovascular diseases in the Iowa Women's Health Study. *American Journal of Clinical Nutrition, 83*(5), 1039-1046.

Anderson, J., Konz, E., Frederick, R., & Wood, C. (2001). Long-term weight-loss maintenance: A meta-analysis of US studies. *American Journal of Clinical Nutrition, 74*, 579-584.

Anderson, J. W., Vichitbandra, S., Qian, W., & Kryscio, R. J. (1999). Long-term weight maintenance after an intensive weight-loss program. *Journal of the American College of Nutrition, 18*(6), 620-627.

Apfelbaum, M., Vague, P., Ziegler, O., Hanotin, C., Thomas, F., & Leutenegger, E. (1999). Long-term maintenance of weight loss after a very-low-calorie diet: A randomized blinded trial of the efficacy and tolerability of sibutramine. *American Journal of Medicine, 106*(2), 179-184.

Aronne, L. J. (2002). Treatment of obesity in the primary care setting. In T. A. Wadden & A. J. Stunkard (Eds.), *Handbook of Obesity Treatment* (pp. 383-394). New York: Guilford Press.

Ash, S., Reeves, M., Bauer, J., Dover, T., Vivanti, A., Leong, C., Sullivan, T. O., & Capra, S. (2006). A randomised control trial comparing lifestyle groups, individual counselling and written information in the management of weight and health outcomes over 12 months. *International Journal of Obesity, 30*, 1557-1564.

Astrup, A., Grunwald, G. K., Melanson, E. L., Saris, W. H., & Hill, J. O. (2000). The role of low-fat diets in body weight control: A meta-analysis of ad libitum dietary intervention studies. *International Journal of Obesity, 24*(12), 1545-1552.

Astrup, A., Toubro, S., Raben, A., & Skov, A. R. (1997). The role of low-fat diets and fat substitutes in body weight management: What have we learned from clinical studies? *Journal of the American Dietetic Association, 97*(Suppl. 7), S82-87.

Atlantis, E., Barnes, E. H., & Ball, K. (2008). Weight status and perception barriers to healthy physical activity and diet behavior. *International Journal of Obesity, 32*, 343-352.

Ayyad, C., & Andersen, T. (2000). Long-term efficacy of dietary treatment of obesity: a systematic review of studies published between 1931 and 1999. *Obesity Reviews, 1*(2), 113-119.

Azadbakht, L., Mirmiran, P., Esmaillzadeh, A., & Azizi, F. (2007). Better dietary adherence and weight maintenance achieved by a long-term moderate-fat diet. *British Journal of Nutrition, 97*, 399-404.

Baker, R. C., & Kirschenbaum, D. S. (1993). Self-monitoring may be necessary for successful weight control. *Behavior Therapy, 24*, 377-394.

Ball, K., & Crawford, D. (2006). An investigation of psychological, social and environmental correlates of obesity and weight gain in young women. *International Journal of Obesity, 30*(8), 1240-1249.

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs: Prentice Hall.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122-147.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs: Prentice Hall.

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development. Six theories of child development* (Vol. 6, pp. 1-60). Greenwich, CT: JAI Press.

Bandura, A. (1994). *Encyclopedia of human behavior* (Vol. 4). New York: Academic Press.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: W.H. Freeman and Company.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*, 1-26.

Barnes, A. S., Goodrick, G. K., Pavlik, V., Markesino, J., Laws, D. Y., & Taylor, W. C. (2007). Weight loss maintenance in African-American women: Focus group results and questionnaire development. *Journal of General Internal Medicine, 22*(7), 915-922.

Barclay, T. R., Hinkin, C. H., Castellon, S. A., Mason, K. I., Reinhard, M. J., Marion, S. D., et al. (2007). Age-associated predictors of medication adherence in HIV-positive adults: Health beliefs, self-efficacy, and neurocognitive status. *Health Psychology, 26*(1), 40-49.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality & Social Psychology, 51*(6), 1173-1182.

Baturka, N., Hornsby, P. P., & Schorling, J. B. (2000). Clinical implications of body image among rural African American women. *Journal of General Internal Medicine, 15*, 235-241.

Bautista-Castano, I., Molina-Cabrillana, J., Montoya-Alonso, J. A., & Serra-Majem, L. (2004). Variables predictive of adherence to diet and physical activity recommendations in the treatment of obesity and overweight, in a group of Spanish subjects. *International Journal of Obesity, 28*(5), 697-705.

Befort, C. A., Stewart, E. E., Smith, B. K., Gibson, C. A., Sullivan, D. K., & Donnelly, J. E. (2007). Weight maintenance, behaviors and barriers among previous participants of a university-based weight control program. *International Journal of Obesity, 32*, 519-526.

Berkel, L. A., Poston, W. S., Reeves, R. S., & Foreyt, J. P. (2005). Behavioral interventions for obesity. *Journal of the American Dietetic Association, 105*(Suppl. 1), S35-43.

Bjorntorp, P. (1997). Body fat distribution, insulin resistance, and metabolic diseases. *Nutrition, 9*, 795-803.

Bjorntorp, P. (2001). Do stress reactions cause abdominal obesity and comorbidities? *Obesity Reviews, 2*(2), 73-86.

Black, P. H. (2006). The inflammatory consequences of psychologic stress: Relationship to insulin resistance, obesity, atherosclerosis and diabetes mellitus, type II. *Medical Hypotheses, 67*(4), 879-891.

Block, J. P., Scribner, R. A., & DeSalvo, K. B. (2004). Fast food, race/ethnicity, and income: A geographic analysis. *American Journal of Preventive Medicine, 27*(3), 211-217.

Booth, K. M., Pinkston, M. M., & Poston, W. S. (2005). Obesity and the built environment. *Journal of the American Dietetic Association, 105*(5 Suppl. 1), S110-117.

Borg, P., Kukkonen-Harjula, K., Fogelholm, M., & Pasanen, M. (2002). Effects of walking or resistance training on weight loss maintenance in obese, middle-aged men: a randomized trial. *International Journal of Obesity, 26*(5), 676-683.

Boutelle, K. N., Kirschenbaum, D. S., Baker, R. C., & Mitchell, M. E. (1999). How can obese weight controllers minimize weight gain during the high risk holiday season? By self-monitoring very consistently. *Health Psychology, 18*(4), 364-368.

Bray, G. A., Paeratakul, S., & Popkin, B. M. (2004). Dietary fat and obesity: A review of animal, clinical and epidemiological studies. *Physiology & Behavior, 83*(4), 549-555.

Brightwell, D. R., & Sloan, C. L. (1977). Long-term results of behavior therapy for obesity. *Behavior Therapy, 8*(5), 898-905.

Brunner, E. J., Chandola, T., & Marmot, M. G. (2007). Prospective effect of job strain on general and central obesity in the Whitehall II Study. *American Journal of Epidemiology, 165*(7), 828-837.

Brydon, L., Wright, C. E., O'Donnell, K., Zachary, I., Wardle, J., & Steptoe, A. (2008). Stress-induced cytokine responses and central adiposity in young women. *International Journal of Obesity, 32*, 443-450.

Buchowski, M. S., Townsend, K. M., Chen, K. Y., Acra, S. A., & Sun, M. (1999). Energy expenditure determined by self-reported physical activity is related to body fatness. *Obesity Research, 7*(1), 23-33.

Burke, L. E., Choo, J., Music, E., Warziski, M., Styn, M. A., Kim, Y., et al. (2006). PREFER study: A randomized clinical trial testing treatment preference and two dietary options in behavioral weight management -- rationale, design and baseline characteristics. *Contemporary Clinical Trials, 27*(1), 34-48.

Burke, L. E., Hudson, A. G., Warziski, M., Styn, M. A., Music, E., Elci, O. U., et al. (2007). Effects of a vegetarian diet and treatment preference on biochemical and dietary variables in overweight and obese adults: A randomized clinical trial. *American Journal of Clinical Nutrition, 86*, 588-596.

Burke, L. E., Kim, Y., & Music, E. (2004). The Barriers to Healthy Eating scale: Psychometric report. *Annals of Behavioral Medicine, 27*(Suppl.), S101.

Burke, L. E., Sereika, S. M., Music, E., Warziski, M., Styn, M. A., & Stone, A. A. (2008). Using instrumented paper diaries to document self-monitoring patterns in weight loss. *Contemporary Clinical Trials, 29*(2), 182-193.

Burke, L. E., Styn, M. A., Steenkiste, A. R., Music, E., Warziski, M., & Choo, J. (2006). A randomized clinical trial testing treatment preference and two dietary options in behavioral weight management: Preliminary results of the impact of diet at 6 months-PREFER study. *Obesity, 14*(11), 2007-2017.

Burke, L. E., Styn, M. A., Elci, O. U., Music, E., & Warziski, M. (2007). How do barriers to healthy eating impact weight loss? *Circulation, 115*(Suppl. 8), 55.

Burke, L. E., Warziski, M., Styn, M. A., Music, E., Hudson, A. G., & Sereika, S. M. (2008). A randomized clinical trial of a standard versus vegetarian diet for weight loss: The impact of treatment preference. *International Journal of Obesity, 32*, 166-176.

Burke, V., Giangiulio, N., Gillam, H. F., Beilin, L. J., & Houghton, S. (2004). Changes in cognitive measures in a randomized controlled trial of a health promotion program for couples targeting diet and physical activity. *American Journal of Health Promotion,* 18(4): 300-311.

Butryn, M. L., Phelan, S., Hill, J. O., & Wing, R. R. (2007). Consistent self-monitoring of weight: A key component of successful weight loss maintenance. *Obesity, 15*(12), 3091-3096.

Buzzard, I., Schakel, S., & Ditter-Johnson, J. (1995). Quality control in the use of food and nutrient databases for epidemiologic studies. In *Quality and accessibility of food-related data* (pp. 241-252). Arlington, VA: AOAC International.

Caldwell, M. B., Brownell, K. D., & Wilfley, D. E. (1997). Relationship of weight, body dissatisfaction, and self-esteem in African-American and White female dieters. *International Journal of Eating Disorders, 22*, 127-130.

Cargill, B. R., Clark, M. M., Pera, V., Niaura, R. S., & Abrams, D. B. (1999). Binge eating, body image, depression, and self-efficacy in an obese clinical population. *Obesity Research, 7*(4), 379-386.

Carter-Edwards, L., Bynoe, M. J., & Svetkey, L. P. (1998). Knowledge of diet and blood pressure among African Americans: Use of focus groups for questionnaire development. *Ethnicity & Disease, 8*(2), 184-197.

Centers for Disease Control and Prevention. (2005). National Diabetes Fact Sheet, United States, 2005. Available at http://apps.nccd.cdc.gov/ddtstrs/template/ndfs_2005.pdf, accessed October 31, 2007.

Centers for Disease Control and Prevention. (2007). Prevalence of overweight and obesity among adults: United States, 2003-2004. Available at http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overweight/overwght_adult_03.htm , accessed October 23, 2007.

Chitwood, L. F., Brown, S. P., Lundy, M. J., & Dupper, M. A. (1996). Metabolic propensity toward obesity in black vs white females: Responses during rest, exercise and recovery. *International Journal of Obesity, 20*(5), 455-462.

Clark, M. M., Abrams, D. B., Niaura, R. S., Eaton, C. A., & Rossi, J. S. (1991). Self-efficacy in weight management. *Journal of Consulting and Clinical Psychology, 59*, 739-744.

Clark, M. M., Cargill, B. R., Medeiros, M. L., & Pera, V. (1996). Changes in self-efficacy following obesity treatment. *Obesearch Research, 4*(2), 179-181.

Clark, M. M., Niaura, R., King, T. K., & Pera, V. (1996). Depression, smoking, activity level, and health status: Pretreatment predictors of attrition in obesity treatment. *Addictive Behaviors, 21*(4), 509-513.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Mahwah: Lawrence Erlbaum Associates.

Condiotte, M. M., & Lichtenstein, E. (1981). Self-efficacy and relapse in smoking cessation programs. *Journal of Consulting and Clinical Psychology 49*(5), 648-658.

Conway, J. M., Ingwersen, L. A., & Moshfegh, A. J. (2004). Accuracy of dietary recall using the USDA five-step multiple-pass method in men: An observational validation study. *Journal of the American Dietetic Association, 104*(4), 595-603.

Cooper, Z., & Fairburn, C. G. (2001). A new cognitive behavioural approach to the treatment of obesity. *Behavioral Research & Therapy, 39*(5), 499-511.

Cossrow, N., & Falkner, B. (2004). Race/ethnic issues in obesity and obesity-related comorbidities. *The Journal of Clinical Endocrinology & Metabolism, 89*(6), 2590-2594.

Cox, T. L., Malpede, C. Z., Desmond, R. A., Faulk, L. E., Myer, R. A., Henson, C. S., et al. (2007). Physical activity patterns during weight maintenance following a low-energy density dietary intervention. *Obesity, 15*(5), 1226-1232.

Crowther, J. H., Sanftner, J., Bonifazi, D. Z., & Shepherd, K. L. (2001). The role of daily hassles in binge eating. *International Journal of Eating Disorders, 29*(4), 449-454.

Cummings, S., Parham, E. S., Strain, G. W., & American Dietetic Association. (2002). Position of the American Dietetic Association: Weight management. *Journal of the American Dietetic Association, 102*(8), 1145-1155.

Dacosta, K. O., & Wilson, J. F. (1996). Food preferences and eating attitudes in three generations of Black and White women. *Appetite, 27*, 183-191.

Dalle Grave, R., Calugi, S., Molinari, E., Petroni, M. L., Bondi, M., Compare, A., et al. (2005). Weight loss expectations in obese patients and treatment attrition: An observational multicenter study. *Obesity Research, 13*(11), 1961-1969.

Dallman, M. F., Pecoraro, N., Akana, S. F., La Fleur, S. E., Gomez, F., Houshyar, H., et al. (2003). Chronic stress and obesity: A new view of "comfort food." *Proceedings of the National Academy of Sciences of the United States of America, 100*(20), 11696-11701.

Dansinger, M. L., Gleason, J. A., Griffith, J. L., Selker, H. P., & Schaefer, E. J. (2005). Comparison of the Atkins, Ornish, Weight Watchers, and Zone diets for weight loss and heart disease risk reduction: A randomized trial. *JAMA, 293*(1), 43-53.

Davidson, L., Ryan, W. J., Rohay, J., & Sereika, S. M. (1996). Technological advances in data entry and verification: Is Teleform for you? *Nursing Research, 45*(2), 373-376.

Davidson, M. H., Hauptman, J., DiGirolamo, M., Foreyt, J. P., Halsted, C. H., Heber, D., et al. (1999). Weight control and risk factor reduction in obese subjects treated for 2 years with orlistat: A randomized controlled trial. *JAMA, 281*(3), 235-242.

Davis, E. M., Clark, J. M., Carrese, J. A., Gary, T. L., & Cooper, L. A. (2005). Racial and socioeconomic differences in the weight-loss experiences of obese women. *American Journal of Public Health, 95*(9), 1539-1543.

Davis, M. C., Twamley, E. W., Hamilton, N. A., & Swan, P. D. (1999). Body fat distribution and hemodynamic stress responses in premenopausal obese women: A preliminary study. *Health Psychology, 18*(6), 625-633.

Dennis, K. E., & Goldberg, A. P. (1996). Weight control self-efficacy types and transitions affect weight-loss outcomes in obese women. *Addictive Behaviors, 21*(1), 103-116.

DePue, J. D., Clark, M. M., Ruggiero, L., Medeiros, M. L., & Pera, V., Jr. (1995). Maintenance of weight loss: A needs assessment. *Obesity Research, 3*(3), 241-248.

Donnelly, J. E., Smith, B., Jacobsen, D. J., Kirk, E., Dubose, K., Hyder, M., et al. (2004). The role of exercise for weight loss and maintenance. *Best Practice & Research in Clinical Gastroenterology, 18*(6), 1009-1029.

Drapkin, R. G., Wing, R. R., & Shiffman, S. (1995). Responses to hypothetical high risk situations: Do they predict weight loss in a behavioral treatment program or the context of dietary relapses? *Health Psychology, 14*(5), 427-434.

Drent, M. L., Larsson, I., William-Olsson, T., Quaade, F., Czubayko, F., von Bergmann, K., et al. (1995). Orlistat (Ro 18-0647), a lipase inhibitor, in the treatment of human obesity: A multiple dose study. *International Journal of Obesity, 19*(4), 221-226.

Du, Y., Melchert, H. U., Knopf, H., Braemer-Hauth, M., Gerding, B., & Pabel, E. (2005). Association of serum caffeine concentrations with blood lipids in caffeine-drug users and nonusers - results of German National Health Surveys from 1984 to 1999. *European Journal of Epidemiology, 20*(4), 311-316.

Due, A., Toubro, S., Skov, A. R., & Astrup, A. (2004). Effect of normal-fat diets, either medium or high in protein, on body weight in overweight subjects: A randomised 1-year trial. *International Journal of Obesity, 28*(10), 1283-1290.

Duncan, G. E., Anton, S. D., Newton, R. L., & Perri, M. G. (2003). Comparison of perceived health to physiological measures of health in Black and White women. *Preventive Medicine, 36*, 624-628.

Dutton, G. R., Martin, P. D., Rhode, P. C., & Brantley, P. J. (2004). Use of the Weight Efficacy Lifestyle questionnaire with African American women: Validation and extension of previous findings. *Eating Behaviors, 5*(4), 375-384.

D'Zurilla, T. J., & Goldfried, M. R. (1971). Problem solving and behavior modification. *Journal of Abnormal Psychology, 78*(1), 107-126.

Early, J. L., Apovian, C. M., Aronne, L. J., Fernstrom, M. H., Frank, A., Greenway, F. L., et al. (2007). Sibutramine plus meal replacement therapy for body weight loss and maintenance in obese patients. *Obesity, 15*(6), 1464-1472.

Eckel, R. H., York, D. A., Rossner, S., Hubbard, V., Caterson, I., St. Jeor, S. T., et al. (2004). American Heart Association Prevention Conference VII: Obesity, a worldwide epidemic related to heart disease and stroke: Executive summary. *Circulation, 110*, 2968-2975.

Eikenberry, N., & Smith, C. (2004). Healthful eating: Perceptions, motivations, barriers, and promotion in low-income Minnesota communities. *Journal of the American Dietetic Association, 104*(7), 1158-1161.

Elder, C., Ritenbaugh, C., Mist, S., Aickin, M., Schneider, J., Zwickey, H., et al. (2007). Randomized trial of two mind-body interventions for weight-loss maintenance. *Journal of Alternative & Complementary Medicine, 13*(1), 67-78.

Elfhag, K., & Rossner, S. (2005). Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obesity Reviews, 6*(1), 67-85.

Epel, E. S., Lapidus, R., McEwen, B., & Brownell, K. D. (2001). Stress may add bite to appetite in women: A laboratory study of stress-induced cortisol and eating behavior. *Psychoneuroendocrinology, 26*, 37-49.

Epel, E. S., McEwen, B., Seeman, T., Matthews, K., Castellazzo, G., Brownell, K. D., et al. (2000). Stress and body shape: Stress-induced cortisol secretion is consistently greater among women with central fat. *Psychosomatic Medicine, 62*(5), 623-632.

Eyler, A. A., Baker, E., Cromer, L., King, A. C., Brownson, R. C., & Donatelle, R. J. (1998). Physical activity and minority women: A qualitative study. *Health Education & Behavior, 25*(5), 640-652.

Field, A. E., Wing, R. R., Manson, J. E., Spiegelman, D. L., & Willett, W. C. (2001). Relationship of a large weight loss to long-term weight change among young and middle-aged US women. *International Journal of Obesity, 25*(8), 1113-1121.

Fisher, L., Dixon, D. O., Herson, J., Frankowski, R. K., Hearron, M. S., & Peace, K. E. (1990). Intention to treat in clinical trials. In K. Peace (Ed.), *Statistical Issues in Drug Research and Development* (pp. 331-350). New York: Marcel Dekker.

Fogelholm, M., Kukkonen-Harjula, K., & Oja, P. (1999). Eating control and physical activity as determinants of short-term weight maintenance after a very-low-calorie diet among obese women. *International Journal of Obesity, 23*(2), 203-210.

Fontaine, K. R., & Cheskin, L. J. (1997). Self-efficacy, attendance, and weight loss in obesity treatment. *Addictive Behaviors, 22*(4), 567-570.

Foster, G. D., Wadden, T. A., Swain, R. M., Anderson, D. A., & Vogt, R. A. (1999). Changes in resting energy expenditure after weight loss in obese African American and white women. *American Journal of Clinical Nutrition, 69*, 13-17.

Foster, G. D., Wyatt, H. R., Hill, J. O., McGucki, B. G., Brill, C., Mohammed, B. S., et al. (2003). A randomized trial of a low-carbohydrate diet for obesity. *New England Journal of Medicine, 348*(21), 2082-2090.

Freedman, L. S., Midthune, D., Carroll, R. J., Krebs-Smith, S., Subar, A. F., Troiano, R. P., et al. (2004). Adjustments to improve the estimation of usual dietary intake distributions in the population. *Journal of Nutrition, 134*(7), 1836-1843.

Freund, A., Johnson, S. B., Silverstein, J., & Thomas, J. (1991). Assessing daily management of childhood diabetes using 24-hour recall interviews: Reliability and stability. *Health Psychology, 10*(3), 200-208.

Fujioka, K. (2002). Management of obesity as a chronic disease: Nonpharmacologic, pharmacologic, and surgical options. *Obesity Research, 10*(Suppl. 2), S116-123.

Fulkerson, J. A., French, S. A., Story, M., Hannan, P. J., & Neumark-Sztainer, D. H. (2004). Weight-bearing physical activity among girls and mothers: Relationships to girls' weight status. *Obesity Research, 12*(2), 258-266.

Gans, K. M., Burkholder, G. J., Risica, P. M., & Lasater, T. M. (2003). Baseline fat-related dietary behaviors of white, Hispanic, and black participants in a cholesterol screening and education project. *Journal of the American Dietetic Association, 103*, 699-706.

Gans, K. M., Kumanyika, S. K., Lovell, H. J., Risica, P. M., Goldman, R., Odoms-Young, A., et al. (2003). The development of SisterTalk: A cable TV-delivered weight control program for black women. *Preventive Medicine, 37*(6), 654-667.

Gerhard, G. T., Ahmann, A., Meeuws, K., McMurry, M. P., Duell, P. B., & Connor, W. E. (2004). Effects of a low-fat diet compared with those of a high-monounsaturated fat diet

on body weight, plasma lipids and lipoproteins, and glycemic control in type 2 diabetes. *American Journal of Clinical Nutrition, 80*(3), 668-673.

Gilden Tsai, A., & Wadden, T. A. (2006). The evolution of very-low-calorie diets: An update and meta-analysis. *Obesity, 14*(8), 1283-1293.

Giusti, V., Suter, M., Heraief, E., Gaillard, R. C., & Burckhardt, P. (2003). Rising role of obesity surgery caused by increase of morbid obesity, failure of conventional treatments and unrealistic expectations: Trends from 1997 to 2001. *Obesity Surgery, 13*(5), 693-698.

Glasgow, R. E., Nelson, C. C., Kearney, K. A., Reid, R., Ritzwoller, D. P., Strecher, V. J., Couper, M. P., Green, B., & Wildenhaus, K. (2007). Reach, engagement, and retention in an Internet-based weight loss program in a multi-site randomized controlled trial. *Journal of Medical Internet Research, 9*(2), e11.

Gluck, M. E., Geliebter, A., & Lorence, M. (2004). Cortisol stress response is positively correlated with central obesity in obese women with binge eating disorder (BED) before and after cognitive-behavioral treatment. *Annals of the New York Academy of Sciences, 1032*, 202-207.

Gorin, A. A., Phelan, S., Wing, R. R., & Hill, J. O. (2004). Promoting long-term weight control: Does dieting consistency matter? *International Journal of Obesity, 28*(2), 278-281.

Gormally, J., Black, S., Daston, S., & Rardin, D. (1982). The assessment of binge eating severity among obese persons. *Addictive Behaviors, 7*, 47-55.

Gosselin, C., & Cote, G. (2001). Weight loss maintenance in women two to eleven years after participating in a commercial program: A survey. *BMC Women's Health,* Available at http://www.biomedcentral.com/1472-6874/1/2, accessed June 1, 2008.

Greenberg, D. R., & LaPorte, D. J. (1996). Racial differences in body type preferences of men for women. *International Journal of Eating Disorders, 19*(3), 275-278.

Greenberg, J. A., Dunbar, C. C., Schnoll, R., Kokolis, R., Kokolis, S., & Kassotis, J. (2007). Caffeinated beverage intake and the risk of heart disease mortality in the elderly: A prospective analysis. *American Journal Clinical Nutrition, 85*, 392-398.

Greene, L. F., Malpede, C. Z., Henson, C. S., Hubbert, K. A., Heimburger, D. C., & Ard, J. D. (2006). Weight maintenance 2 years after participation in a weight loss program promoting low-energy density foods. *Obesity, 14*(10), 1795-1801.

Guthrie, J. F., & Saltos, E. A. (1995). Personal characteristics and fat intakes of individuals who use food labels to check the fat content of foods. *Journal of the American Dietetic Association, 95*(9, Supp. 1), A66.

Hagler, A. S., Norman, G. J., Zabinski, M. F., Sallis, J. F., Calfus, K. J., & Patrick, K. (2007). Psychosocial correlates of dietary intake among overweight and obese men. *American Journal of Health Behavior, 31*(1), 3-12.

Haire-Joshu, D., Brownson, R. C., Schechtman, K., & Nanney, M. S. (2001). A community research partnership to improve the diet of African Americans. *American Journal of Health Behavior, 25*(2), 140-147.

Harvey-Berino, J., Pintauro, S., Buzzell, P., & Gold, E. C. (2004). Effect of internet support on the long-term maintenance of weight loss. *Obesity Research, 12*(2), 320-329.

Harvey-Berino, J., Pintauro, S. J., Buzzell, P., DiGiulio, M., Casey Gold, B., Moldovan, C., et al. (2002a). Does using the Internet facilitate the maintenance of weight loss? *International Journal of Obesity, 26*(9), 1254-1260.

Harvey-Berino, J., Pintauro, S. J., & Gold, E. C. (2002b). The feasibility of using Internet support for the maintenance of weight loss. *Behavior Modification, 26*(1), 103-116.

Haskell, W. L., Lee, I. M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., et al. (2007). Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation, 116*(9), 1081-1093.

Hauner, H., Petzinna, D., Sommerauer, B., & Toplak, H. (2001). Effect of acarbose on weight maintenance after dietary weight loss in obese subjects. *Diabetes, Obesity & Metabolism, 3*(6), 423-427.

Henry, H., Reimer, K., Smith, C., & Reicks, M. (2006). Associations of decisional balance, processes of change, and self-efficacy with stages of change for increased fruit and vegetable intake among low-income, African-American mothers. *Journal of the American Dietetic Association, 106,* 841-849.

Heshka, S., Anderson, J. W., Atkinson, R. L., Greenway, F. L., Hill, J. O., Phinney, S. D., et al. (2003). Weight loss with self-help compared with a structured commercial program: A randomized trial. *JAMA, 289*(14), 1792-1798.

Hill, J. O. (1998). Dealing with obesity as a chronic disease. *Obesity Research, 6*(Suppl. 1), S34-38.

Hill, J. O., Hauptman, J., Anderson, J. W., Fujioka, K., O'Neil, P. M., Smith, D. K., et al. (1999). Orlistat, a lipase inhibitor, for weight maintenance after conventional dieting: A 1-y study. *American Journal of Clinical Nutrition, 69*(6), 1108-1116.

Hill, J. O., & Peters, J. C. (1998). Environmental contributions to the obesity epidemic. *Science, 280*(5368), 1371-1374.

Hill, R. J., & Davies, P. S. (2001). The validity of self-reported energy intake as determined using the doubly labelled water technique. *British Journal of Nutrition, 85*(4), 415-430.

Hinkin, C. H., Hardy, D. J., Mason, K. I., Castellon, S. A., Durvasula, R. S., Lam, M. N., et al. (2004). Medication adherence in HIV-infected adults: Effect of patient age, cognitive status, and substance abuse. *AIDS, 18*(1), 1.

Hosmer, D. W., & Lemeshow, S. (2000). *Applied Logistic Regression* (2nd ed.). New York: John Wiley & Sons.

Howard, B. V., Manson, J. E., Stefanick, M. L., Beresford, S. A., Frank, G., Jones, B., et al. (2006). Low-fat dietary pattern and weight change over 7 years: The Women's Health Initiative Dietary Modification Trial. *JAMA, 295*(1), 39-49.

Hufford, M. R., & Shiffman, S. (2003). Assessment methods for patient-reported outcomes. *Disease Management and Health Outcomes, 11*(2), 77-86.

Irwin, M. L., Ainsworth, B. E., & Conway, J. M. (2001). Estimation of energy expenditure from physical activity measures: Determinants of accuracy. *Obesity Research, 9*(9), 517-525.

Jakicic, J. (2003). Exercise strategies for the obese patient. *Primary Care, 30*(2), 393-403.

Jakicic, J. M., Clark, K., Coleman, E., Donnelly, J. E., Foreyt, J., Melanson, E., et al. (2001). Appropriate intervention strategies for weight loss and prevention of weight regain for adults. *Medicine & Science in Sports & Exercise, 33*(12), 2145-2156.

Jakicic, J. M., Marcus, B. H., Gallagher, K. I., Napolitano, M., & Lang, W. (2003). Effect of exercise duration and intensity on weight loss in overweight, sedentary women: A randomized trial. *JAMA, 290*(10), 1323-1330.

Jakicic, J. M., & Otto, A. D. (2005). Physical activity recommendations in the treatment of obesity. *Psychiatric Clinics North America, 28*(1), 141-150.

Jakicic, J. M., Polley, B. A., & Wing, R. R. (1998). Accuracy of self-reported exercise and the relationship with weight loss in overweight women. *Medicine & Science in Sports & Exercise, 30*(4), 634-638.

Jakicic, J. M., & Wing, R. R. (1998). Differences in resting energy expenditure in African-American vs Caucasian overweight females. *International Journal of Obesity, 22*(3), 236-242.

Jakicic, J. M., Winters, C., Lang, W., & Wing, R. R. (1999). Effects of intermittent exercise and use of home exercise equipment on adherence, weight loss, and fitness in overweight women: A randomized trial. *JAMA, 282*(16), 1554-1560.

James, J. E. (2004). Critical review of dietary caffeine and blood pressure: A relationship that should be taken more seriously. *Psychosomatic Medicine, 66*(1), 63-71.

James, W. P., Astrup, A., Finer, N., Hilsted, J., Kopelman, P., Rossner, S., et al. (2000). Effect of sibutramine on weight maintenance after weight loss: A randomised trial. *Lancet, 356*(9248), 2119-2125.

Jeffery, R. W., Drewnowski, A., Epstein, L. H., Stunkard, A. J., Wilson, G. T., Wing, R. R., et al. (2000). Long-term maintenance of weight loss: Current status. *Health Psychology, 19*(Suppl. 1), 5-16.

Jeffery, R. W., Hellerstedt, W. L., French, S. A., & Baxter, J. E. (1995). A randomized trial of counseling for fat restriction versus calorie restriction in the treatment of obesity. *International Journal of Obesity, 19*, 132-137.

Jeffery, R. W., McGuire, M. T., & French, S. A. (2002). Prevalence and correlates of large weight gains and losses. *International Journal of Obesity, 26*(7), 969-972.

Jeffery, R. W., Vender, M., & Wing, R. R. (1978). Weight loss and behavior change 1 year after behavioral treatment for obesity. *Journal of Consulting and Clinical Psychology, 46*(2), 368-369.

Jeffery, R. W., Wing, R. R., Thorson, C., Burton, L. R., Raether, C., Harvet, J., et al. (1993). Strengthening behavioral interventions for weight loss: A randomized trial of food provision and monetary incentives. *Journal of Consulting and Clinical Psychology, 61*, 1038-1045.

Jen, K. L., Brogan, K., Washington, O. G., Flack, J. M., & Artinian, N. T. (2007). Poor nutrient intake and high obese rate in an urban African American population with hypertension. *Journal of the American College of Nutrition, 26*(1), 57-65.

Johansson, G., Wikman, A., Ahren, A., Hallmans, G., & Johnansson, I. (2001). Underreporting of energy intake in repeated 24-hour recalls related to gender, age, weight status, day of interview, education level, reported food intake, smoking habits and area of living. *Public Health Nutrition, 4*(4), 919-927.

Karhunen, L., Franssila-Kallunki, A., Rissanen, P., Valve, R., Kolehmainen, M., Rissanen, A., et al. (2000). Effect of orlistat treatment on body composition and resting energy expenditure during a two-year weight-reduction programme in obese Finns. *International Journal of Obesity, 24*(12), 1567-1572.

Kayman, S., Bruvold, W., & Stem, J. S. (1990). Maintenance and relapse after weight loss in women: Behavioral aspects. *American Journal of Clinical Nutrition, 52*(5), 800-807.

Kearney, J. M., & McElhone, S. (1999). Perceived barriers in trying to eat healthier--Results of a pan-EU consumer attitudinal survey. *British Journal of Nutrition, 81*(2), S133-137.

Kelsey, K., Earp, J. A. L., & Kirkley, B. G. (1997). Is social support beneficial for dietary change? A review of the literature. *Family & Community Health, 20*, 70-82.

Khaodhiar, L., & Blackburn, G. L. (2002). Obesity treatment: factors involved in weight-loss maintenance and regain. *Current Opinion in Endocrinology & Diabetes, 9*, 369-374.

Kim, Y., Burke, L. E., Music, E., Cartwright, M., Polakoski, T., & Tschirpke, D. (2004). Measurement qualities of the Experiences Associated With Following a Low-Fat Diet scale. *Annals of Behavioral Medicine, 27*, (Suppl.), S101.

King, T. K., Clark, M. M., & Pera, V. (1996). History of sexual abuse and obesity treatment outcome. *Addictive Behaviors, 21*, 283-290.

Kipnis, V., Midthune, D., Freedman, L., Bingham, S., Day, N. E., Riboli, E., et al. (2002). Bias in dietary-report instruments and its implications for nutritional epidemiology. *Public Health Nutrition, 5*(6A), 915-923.

Kitsantas, A. (2000). The role of self-regulation strategies and self-efficacy perceptions in successful weight loss maintenance. *Psychology and Health, 15*, 811-820.

Kivimaki, M., Head, J., Ferrie, J. E., Shipley, M. J., Brunner, E., Vahtera, J., et al. (2006). Work stress, weight gain and weight loss: Evidence for bidirectional effects of job strain on body mass index in the Whitehall II study. *International Journal of Obesity, 30*(6), 982-987.

Klein, S., Burke, L. E., Bray, G. A., Blair, S., Allison, D. B., Pi-Sunyer, X., et al. (2004). Clinical implications of obesity with specific focus on cardiovascular disease. A statement for professionals from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism. *Circulation, 110*, 2952-2967.

Klem, M. L., Wing, R. R., Lang, W., McGuire, M. T., & Hill, J. O. (2000). Does weight loss maintenance become easier over time? *Obesity Research, 8*(6), 438-444.

Klem, M. L., Wing, R. R., McGuire, M. T., Seagle, H. M., & Hill, J. O. (1997). A descriptive study of individuals successful at long-term maintenance of substantial weight loss. *American Journal of Clinical Nutrition, 66*(2), 239-246.

Knowler, W. C., Barrett-Connor, E., Fowler, S. E., Hamman, R. F., Lachin, J. M., Walker, E. A., et al. (2002). Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *New England Journal of Medicine, 346*(6), 393-403.

Koo-Loeb, J. H., Costello, N., Light, K. C., & Girdler, S. S. (2000). Women with eating disorder tendencies display altered cardiovascular, neuroendocrine, and pyschosocial profiles. *Psychosomatic Medicine, 62*, 539-548.

Korkeila, M., Kaprio, J., Rissanen, A., Koskenvuo, M., & Sorensen, T. (1998). Predictors of major weight gain in adult Finns: Stress, life satisfaction, and personality traits. *International Journal of Obesity, 22*, 949-957.

Kovacs, E. M., Lejeune, M. P., Nijs, I., & Westerterp-Plantenga, M. S. (2004). Effects of green tea on weight maintenance after body-weight loss. *British Journal of Nutrition, 91*(3), 431-437.

Kramer, F. M., Jeffery, R. W., Snell, M. K., & Forster, J. L. (1986). Maintenance of successful weight loss over 1 year: Effects of financial contracts for weight maintenance or participation in skills training. *Behavior Therapy, 17*(3), 295-301.

Kruger, J., Blanck, H. M., & Gillespie, C. (2006). Dietary and physical activity behaviors among adults successful at weight loss maintenance. *International Journal of Behavioral Nutrition & Physical Activity, 3*(17), 1-10.

Kuczmarski, M. F., Kuczmarski, R. J., & Najjar, M. (2001). Effects of age on validity of self-reported height, weight, and body mass index: Findings from the Third National Health and Nutrition Examination Survey, 1988-1994. *Journal of the American Dietetic Association, 101*(1), 28-34.

Kumanyika, S. K. (1993). National Institutes of Health Technology Assessment Conference: Special issues regarding obesity in minority populations. *Annals of Internal Medicine, 119*(Suppl. 7), 650-654.

Kumanyika, S. K. (2002). Obesity treatment in minorities. In T. A. Wadden & A. J. Stunkard (Eds.), *Handbook of obesity treatment*. New York: Guilford Press.

Kumanyika, S. K., Espeland, M. A., Bahnson, J. L., Bottom, J. B., Charleston, J. B., Folmar, S., et al. (2002). Ethnic comparison of weight loss in the Trial of Nonpharmacologic Interventions in the Elderly. *Obesity Research, 10*(2), 96-106.

Kumanyika, S. K., Gary, T. L., Lancaster, K. J., Samuel-Hodge, C. D., Banks-Wallace, J., Beech, B. M., et al. (2005). Achieving healthy weight in African-American communities: Research perspectives and priorities. *Obesity Research, 13*(12), 2037-2047.

Kumanyika, S. K., & Morssink, C. B. (1997). Cultural appropriateness of weight management. In S. Dalton (Ed.), *Overweight and weight management: The health professional's guide to understanding and treatment* (pp. 69-105). New York: Jones & Barlett.

Kumanyika, S. K., Morssink, C., & Agurs, T. (1992). Models for dietary and weight change in African-American women: Identifying cultural components. *Ethnicity & Disease, 2*(2), 166-175.

Kumanyika, S. K., Obarzanek, E., Stevens, V. J., Hebert, P. R., & Whelton, P. K. (1991). Weight-loss experience of black and white participants in the NHLBI-sponsored clinical trials. *American Journal of Clinical Nutrition, 53*(6S), S1631-1638.

Kumanyika, S. K., Shults, J., Fassbender, J., Whitt, M. C., Brake, V., Kallan, M. J., et al. (2005). Outpatient weight management in African-Americans: The Healthy Eating and Lifestyle Program (HELP) study. *Preventive Medicine, 41*(2), 488-502.

Kyrou, I., Chrousos, G. P., & Tsigos, C. (2006). Stress, visceral obesity, and metabolic complications. *Annals of the New York Academy of Sciences, 1083*, 77-110.

Laaksonen, D. E., Laitinen, T., Schonberg, J., Rissanen, A., & Niskanen, L. K. (2003). Weight loss and weight maintenance, ambulatory blood pressure and cardiac autonomic tone in obese persons with the metabolic syndrome. *Journal of Hypertension, 21*(2), 371-378.

Lantz, P. M., House, J. S., Lepkowski, J. M., Williams, D. R., Mero, R. P., & Chen, J. (1998). Socioeconomic factors, health behaviors, and mortality: Results from a nationally representative prospective study of US adults. *JAMA, 279,* 1703-1708.

Lantz, H., Peltonen, M., Agren, L., & Torgerson, J. S. (2003). Intermittent versus on-demand use of a very low calorie diet: A randomized 2-year clinical trial. *Journal of Internal Medicine, 253*(4), 463-471.

Lappalainen, R., Saba, A., Holm, L., Mykkanen, H., Gibney, M. J., & Moles, A. (1997). Difficulties in trying to eat healthier: Descriptive analysis of perceived barriers for healthy eating. *European Journal of Clinical Nutrition, 51*(2), S36-40.

Lavie, C. J., & Milani, R. V. (1997). Effects of cardiac rehabilitation, exercise training, and weight reduction on exercise capacity, coronary risk factors, behavioral characteristics, and quality of life in obese coronary patients. *American Journal of Cardiology, 79*(4), 397-401.

LeCheminant, J. D., Jacobsen, D. J., Hall, M. A., & Donnelly, J. E. (2005). A comparison of meal replacements and medication in weight maintenance after weight loss. *Journal of the American College of Nutrition, 24*(5), 347-353.

Leermakers, E. A., Perri, M. G., Shigaki, C. L., & Fuller, P. R. (1999). Effects of exercise-focused versus weight-focused maintenance programs on the management of obesity. *Addictive Behaviors, 24*(2), 219-227.

Leibbrand, R., & Fichter, M. M. (2002). Maintenance of weight loss after obesity treatment: Is continuous support necessary? *Behaviour Research & Therapy, 40*(11), 1275-1289.

Lejeune, M. P., Kovacs, E. M., & Westerterp-Plantenga, M. S. (2005). Additional protein intake limits weight regain after weight loss in humans. *British Journal of Nutrition, 93*(2), 281-289.

Leser, M. S., Yanovski, S. Z., & Yanovski, J. A. (2002). A low-fat intake and greater activity level are associated with lower weight regain 3 years after completing a very-low-calorie diet. *Journal of the American Dietetic Association, 102*(9), 1252-1256.

Lichtman, S. W., Pisarska, K., Berman, E. R., Pestone, M., Dowling, H., Offenbacher, E., et al. (1992). Discrepancy between self-reported and actual caloric intake and exercise in obese subjects. *New England Journal of Medicine, 327*(27), 1893-1898.

Linde, J. A., Jeffery, R. W., Finch, E. A., Ng, D. M., & Rothman, A. J. (2004). Are unrealistic weight loss goals associated with outcomes for overweight women? *Obesity Research, 12*, 569-576.

Linde, J. A., Jeffrey, R. W., Levy, R. L., Sherwood, N. E., Utter, J., Pronk, N. P., et al. (2004). Binge eating disorder, weight control self-efficacy, and depression in overweight men and women. *International Journal of Obesity, 28*, 418-425.

Linde, J. A., Rothman, A. J., Baldwin, A. S., & Jeffery, R. W. (2006). The impact of self-efficacy on behavior change and weight change among overweight participants in a weight loss trial. *Health Psychology, 25*(3), 282-291.

Lindstrom, J., Louheranta, A., Mannelin, M., Rastas, M., Salminen, V., Eriksson, J., et al. (2003). The Finnish Diabetes Prevention Study (DPS): Lifestyle intervention and 3-year results on diet and physical activity. *Diabetes Care, 26*(12), 3230-3236.

Lindstrom, J., Peltonen, M., Eriksson, J. G., Louheranta, A., Fogelholm, M., Uusitupa, M., et al. (2006). High-fibre, low-fat diet predicts long-term weight loss and decreased type 2 diabetes risk: The Finnish Diabetes Prevention Study. *Diabetologia, 49*(5), 912-920.

Lissner, L. (2002). Measuring food intake in studies of obesity. *Public Health Nutrition, 5*(6A), 889-892.

Livingstone, M. B. & Black, A. E. (2003). Markers of the validity of reported energy intake. *Journal of Nutrition, 133*(Suppl. 3), 895S-920S.

Lopez-Garcia, E., van Dam, R. M., Rajpathak, S., Willett, W. C., Manson, J. E., & Hu, F. B. (2006). Changes in caffeine intake and long-term weight change in men and women. *American Journal of Clinical Nutrition, 83*(3), 674-680.

Lowe, M. R., Miller-Kovach, K., & Phelan, S. (2001). Weight-loss maintenance in overweight individuals one to five years following successful completion of a commercial weight loss program. *International Journal of Obesity, 25*, 325-331.

Mann, D. V., Ho, C. S., Critchley, L., Fok, B. S., Pang, E. W., Lam, C. W., et al. (2007). Affordable measurement of human total energy expenditure and body composition using one-tenth dose doubly labelled water. *International Journal of Obesity, 31*, 751-755.

Marlatt, G. A., & Gordon, J. R. (1980). Determinants of relapse: Implications for the maintenance of behavior change. In P. O. Davidson & S. M. Davidson (Eds.), *Behavioral Medicine: Changing Health Lifestyles* (pp. 410-452). New York: Brunner/Mazel.

Martin, C. K., O'Neil, P. M., & Binks, M. (2002). An attempt to identify predictors of treatment outcome in two comprehensive weight loss programs. *Eating Behaviors, 3*, 239-248.

Martin, L. J., Su, W., Jones, P. J., Lockwood, G. A., Tritchler, D. L., & Boyd, N. F. (1996). Comparison of energy intakes determined by food records and doubly labeled water in women participating in a dietary-intervention trial. *American Journal of Clinical Nutrition, 63*(4), 483-490.

Martin, P. D., Dutton, G. R., & Brantley, P. J. (2003). Self-efficacy as a predictor of weight change in African-American women. *Obesity Research, 12*(4), 646-651.

Masuo, K., Mikami, H., Ogihara, T., & Tuck, M. L. (2001). Weight reduction and pharmacologic treatment in obese hypertensives. *American Journal of Hypertension, 14*(6 Pt 1), 530-538.

Mathus-Vliegen, E. M., for Balance Study Group. (2005). Long-term maintenance of weight loss with sibutramine in a GP setting following a specialist guided very-low-calorie diet: A double-blind, placebo-controlled, parallel group study. *European Journal of Clinical Nutrition, 59*(Suppl. 1), S31-S38.

McGuire, M. T., Wing, R. R., & Hill, J. O. (1999). The prevalence of weight loss maintenance among American adults. *International Journal of Obesity, 23*(12), 1314-1319.

McGuire, M. T., Wing, R. R., Klem, M. L., Lang, W., & Hill, J. O. (1999). What predicts weight regain in a group of successful weight losers? *Journal of Consulting & Clinical Psychology, 67*(2), 177-185.

McGuire, M. T., Wing, R. R., Klem, M. L., Seagle, H. M., & Hill, J. O. (1998). Long-term maintenance of weight loss: Do people who lose weight through various weight loss methods use different behaviors to maintain their weight? *International Journal of Obesity, 22*(6), 572-577.

McInnis, K. J. (2000). Exercise and obesity. *Coronary Artery Disease, 11*(2), 111-116.

McLean, N., Griffin, S., Toney, K., & Hardeman, W. (2003). Family involvement in weight control, weight maintenance and weight-loss interventions: A systematic review of randomised trials. *International Journal of Obesity, 27*(9), 987-1005.

McManus, K., Antinoro, L., & Sacks, F. (2001). A randomized controlled trial of a moderate-fat, low-energy diet compared with a low fat, low-energy diet for weight loss in overweight adults. *International Journal of Obesity, 25*(10), 1503-1511.

McNeely, W., & Goa, K. L. (1998). Sibutramine. A review of its contribution to the management of obesity. *Drugs, 56*(6), 1093-1124.

Medeiros, L., & Zies, S. (1996). Label reading program impacts Ohioans. *Journal of the American Dietetic Association, 96*(9, Supp. 1), A101.

Mendonca, P. J., & Brehm, S. S. (1983). Effects of choice on behavioral treatment of overweight children. *Journal of Social and Clinical Psychology, 1*(4), 343-358.

Mertens, I. L., & Van Gaal, L. F. (2000). Overweight, obesity, and blood pressure: The effects of modest weight reduction. *Obesity Research, 8*(3), 270-278.

Mertz, W., Tsui, J. C., Judd, J. T., Reiser, S., Hallfrisch, J., Morris, E. R., et al. (1991). What are people really eating? The relation between energy intake derived from estimated diet records and intake determined to maintain body weight. *American Journal of Clinical Nutrition, 54*(2), 291-295.

Miller, P. M., Watkins, J. A., Sargent, R. G., & Rickert, E. J. (1999). Self-efficacy in overweight individuals with binge eating disorder. *Obesity Research, 7*(6), 552-555.

Mokdad, A. H., Ford, E. S., Bowman, B. A., Dietz, W. H., Vinicor, F., Bales, V. S., et al. (2003). Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA, 289*(1), 76-79.

Morland, K., Wing, S., Diez Roux, A., & Poole, C. (2002). Neighborhood characteristics associated with the location of food stores and food service places. *American Journal of Preventive Medicine, 22*(1), 23-29.

Muhlheim, L. S., Allison, D. B., Heshka, S., & Heymsfield, S. B. (1998). Do unsuccessful dieters intentionally underreport food intake? *International Journal of Eating Disorders, 24*(3), 259-266.

Munro, B. H. (2005). *Statistical Methods for Health Care Research* (5th ed.). Philadelphia: Lippincott Williams & Wilkins.

Murray, D. C. (1976). Preferred versus nonpreferred treatment, and self-control training versus determination raising as treatments of obesity: A pilot study. *Psychological Reports, 38*, 191-198.

Must, A., Spadano, J., Coakley, E. H., Field, A. E., Colditz, G., & Dietz, W. H. (1999). The disease burden associated with overweight and obesity. *JAMA, 282*(16), 1523-1529.

Must, A., Willett, W. C., & Dietz, W. H. (1993). Remote recall of childhood height, weight, and body build by elderly subjects. *American Journal of Epidemiology, 138*(1), 56-64.

Mustajoki, P., & Pekkarinen, T. (1999). Maintenance programmes after weight reduction- how useful are they? *International Journal of Obesity, 23*(6), 553-555.

National Heart Lung and Blood Institute, & North American Association for the Study of Obesity. (2000). Practical guide to the identification, evaluation, and treatment of overweight and obesity in adults. Available at http://www.nhlbi.nih.gov/guidelines/obesity/prctgd_c.pdf, accessed October 1, 2007.

National Heart Lung and Blood Institute Obesity Education Initiative Expert Panel on the Identification Evaluation and Treatment of Overweight and Obesity. (1998). *Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: The evidence report*. Bethesda, MD: National Institutes of Health.

Nelson, K. M., McFarland, L., & Relber, G. (2007). Factors influencing disease self-managment among veterans with diabetes and poor glycemic control. *Journal of General Internal Medicine, 22*, 442-447.

Neter, J. E., Stam, B. E., Kok, F. J., Grobbee, D. E., & Geleijnse, J. M. (2003). Influence of weight reduction on blood pressure: a meta-analysis of randomized controlled trials. *Hypertension, 42*(5), 878-884.

Neuhouser, M. L., Kristal, A. R., & Patterson, R. E. (1999). Use of food nutrition labels is associated with lower fat intake. *Journal of the American Dietetic Association, 99*(1), 45-53.

Newman, E., O'Connor, D. B., & Conner, M. (2007). Daily hassles and eating behaviour: The role of cortisol reactivity status. *Psychoneuroendocrinology, 32*(2), 125-132.

Niemeier, H. M., Phelan, S., Fava, J. L., & Wing, R. R. (2007). Internal disinhibition predicts weight regain following weight loss and weight loss maintenance. *Obesity, 15*(10), 2485-2494.

Nies, M. A., Buffington, C., Cowan, G., & Hepworth, J. T. (1998). Comparison of lifestyles among obese and nonobese African American and European American women in the community. *Nursing Research, 47*(4), 251-257.

Nothwehr, F. (2004). Attitudes and behaviors related to weight control in two diverse populations. *Preventive Medicine, 39*, 674-680.

Nunnally, J. C., & Bernstein, I. (1994). *Psychometric theory* (3rd ed.). New York: McGraw-Hill.

O'Connell, J. M., Braitstein, P., Hogg, R. S., Yip, B., Craib, K. J., O'Shaughnessy, M. V., et al. (2003). Age, adherence and injection drug use predict virological suppression among men and women enrolled in a population-based antiretroviral drug treatment programme. *Antiviral Therapy, 8*(6), 569-576.

Ogden, C., Carroll, M., Curtin, L., McDowell, M., Tabak, C., & Flegal, K. (2006). Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA, 295*(13), 1549-1555.

Ogden, J. (2000). The correlates of long-term weight loss: A group comparison study of obesity. *International Journal of Obesity, 24*(8), 1018-1125.

Oslin, D. W., Pettinati, H., & Volpicelli, J. R. (2002). Alcoholism treatment adherence: Older age predicts better adherence and drinking outcomes. *American Journal of Geriatric Psychiatry, 10*(6), 740-747.

Oster, G., & Thompson, D. (1996). Estimated effects of reducing dietary saturated fat intake on the incidence and costs of coronary heart disease in the United States. *Journal of the American Dietetic Association, 96*(2), 127-131.

Padwal, R., Kezouh, A., Levine, M., & Etminan, M. (2007). Long-term persistence with orlistat and sibutramine in a population-based cohort. *International Journal of Obesity, 31*, 1567-1570.

Padwal, R., Li, S. K., & Lau, D. C. (2003). Long-term pharmacotherapy for overweight and obesity: A systematic review and meta-analysis of randomized controlled trials. *International Journal of Obesity, 27*(12), 1437-1446.

Paffenbarger Physical Activity Questionnaire: A collection of physical activity questionnaires for health related research. (1997). *Medicine & Science in Sports & Exercise, 29*(Suppl. 6), 83-88.

Paffenbarger, R. S., Wing, A. L., & Hyde, R. T. (1978). Physical activity as an index of heart attack risk in college alumni. *American Journal of Epidemiology, 108*, 161-175.

Palta, M., Prineas, R. J., Berman, R., & Hannan, P. (1982). Comparison of self-reported and measured height and weight. *American Journal of Epidemiology, 115*(2), 223-230.

Pasman, W. J., Westerterp-Plantenga, M. S., Muls, E., Vansant, G., van Ree, J., & Saris, W. H. (1997a). The effectiveness of long-term fibre supplementation on weight maintenance in weight-reduced women. *International Journal of Obesity, 21*(7), 548-555.

Pasman, W. J., Westerterp-Plantenga, M. S., & Saris, W. H. (1997b). The effectiveness of long-term supplementation of carbohydrate, chromium, fibre and caffeine on weight maintenance. *International Journal of Obesity, 21*(12), 1143-1151.

Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry, 18*(2), 189-193.

Perri, M. G. (1998). The maintenance of treatment effects in the long-term management of obesity. *Clinical Psychology: Scientific Practice, 5*, 526-543.

Perri, M. G., & Corsica, J. A. (2002). Improving the maintenance of weight lost in behavioral treatment of obesity. In T. A. Wadden & A. J. Stunkard (Eds.), *Handbook of obesity treatment* (pp. 357-379). New York: Guilford Press.

Perri, M. G., & Foreyt, J. P. (2004). Preventing weight regain after weight loss. In G. A. Bray & C. Bouchard (Eds.), *Handbook of obesity: Clinical applications* (2nd ed., pp. 185-199). New York: Marcel Dekker, Inc.

Perri, M. G., Martin, A. D., Leermakers, E. A., Sears, S. F., & Notelovitz, M. (1997). Effects of group- versus home-based exercise in the treatment of obesity. *Journal of Consulting & Clinical Psychology, 65*(2), 278-785.

Perri, M. G., McAdoo, W. G., McAllister, D. A., Lauer, J. B., & Yancey, D. Z. (1986). Enhancing the efficacy of behavior therapy for obesity: Effects of aerobic exercise and a multicomponent maintenance program. *Journal of Consulting & Clinical Psychology, 54*(5), 670-675.

Perri, M. G., McAdoo, W. G., Spevak, P. A., & Newlin, D. B. (1984a). Effect of a multicomponent maintenance program on long-term weight loss. *Journal of Consulting & Clinical Psychology, 52*(3), 480-481.

Perri, M. G., McAllister, D. A., Gange, J. J., Jordan, R. C., McAdoo, G., & Nezu, A. M. (1988). Effects of four maintenance programs on the long-term management of obesity. *Journal of Consulting & Clinical Psychology, 56*(4), 529-534.

Perri, M. G., Nezu, A. M., McKelvey, W. F., Shermer, R. L., Renjilian, D. A., & Viegener, B. J. (2001). Relapse prevention training and problem-solving therapy in the long-term management of obesity. *Journal of Consulting & Clinical Psychology, 69*(4), 722-726.

Perri, M. G., Sears, S. F., Jr., & Clark, J. E. (1993). Strategies for improving maintenance of weight loss. Toward a continuous care model of obesity management. *Diabetes Care, 16*(33), 200-209.

Perri, M. G., Shapiro, R. M., Ludwig, W. W., Twentyman, C. T., & McAdoo, W. G. (1984b). Maintenance strategies for the treatment of obesity: An evaluation of relapse prevention training and posttreatment contact by mail and telephone. *Journal of Consulting & Clinical Psychology, 52*(3), 404-413.

Pescatello, L. S., & VanHeest, J. L. (2000). Physical activity mediates a healthier body weight in the presence of obesity. *British Journal of Sports Medicine, 34*(2), 86-93.

Peterson, S. J., & Bredow, T. S. (2004). *Middle Range Theories: Application to Nursing Research*. Philadelphia: Lippincott Williams & Wilkins.

Phelan, S., Hill, J. O., Lang, W., Dibelllo, J. R., & Wing, R. R. (2003). Recovery from relapse among successful weight maintainers. *American Journal of Clinical Nutrition, 78*, 1079-1084.

Pinto, B. M., Borrelli, B., King, T. K., Bock, B. C., Clark, M. M., Roberts, M., & Marcus, B. H. (1999). Weight control smoking among sedentary women. *Addictive Behaviors, 24*(1), 75-86.

Pinto, B. M., Clark, M. M., Cruess, D. G., Syzmanski, L., & Pera, V. (1999). Changes in self-efficacy and decisional balance for exercise among obese women in a weight management program. *Obesity Research, 7*(3), 288-292.

Pirozzo, S., Summerbell, C., Cameron, C., & Glasziou, P. (2002). Advice on low-fat diets for obesity. *Cochrane Database of Systematic Reviews, 2*, Art. No. CD003640.

Pi-Sunyer, F. X. (2007). How effective are lifestyle changes in the prevention of type 2 diabetes mellitus? *Nutrition Reviews, 65*(3), 101-110.

Pittler, M. H., & Ernst, E. (2005). Complementary therapies for reducing body weight: A systematic review. *International Journal of Obesity, 29*(9), 1030-1038.

Pocock, S. J., & Simon, R. M. (1975). Sequential treatment assignment with balancing for prognostic factors in the controlled clinical trials. *Biometrics, 31*, 103-115.

Powell, L. A., Nieman, D. C., Melby, C., Cureton, K., Schmidt, D., Howley, E. T., et al. (2001). Assessment of body composition change in a community-based weight management program. *Journal of the American College of Nutrition, 20*(1), 26-31.

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, *36*(4), 717-731.

Prentice, A. M. (2002). Measurement of energy expenditure. In C. G. Fairburn & K. D. Brownell (Eds.), *Eating disorders and obesity* (pp. 131-135). New York: Guilford Press.

Pronk, N. P., & Wing, R. R. (1994). Physical activity and long-term maintenance of weight loss. *Obesity Research, 2*(6), 587-599.

Ravussin, E., Harper, I. T., Rising, R., & Bogardus, C. (1991). Energy expenditure by doubly labeled water: Validation in lean and obese participants. *American Journal of Physiology, 261*, E402-E409.

Raynor, D. A., Phelan, S., Hill, J. O., & Wing, R. R. (2006). Television viewing and long-term weight maintenance: Results from the National Weight Control Registry. *Obesity, 14*(10), 1816-1824.

Raynor, H. A., Jeffery, R. W., Phelan, S., Hill, J. O., & Wing, R. R. (2005). Amount of food group variety consumed in the diet and long-term weight loss maintenance. *Obesity Research, 13*(5), 883-890.

Reinli, K., Will, J. C., Thompson-Reid, P., Liburd, L., & Anderson, L. A. (1996). Predicting barriers to healthy eating physical activity among Black women. *Journal of Women's Health, 5*(1), 51-59.

Renjilian, D. A., Perri, M. G., Nezu, A. M., McKelvey, W. F., Shermer, R. L., & Anton, S. D. (2001). Individual versus group therapy for obesity: Effects of matching participants to their treatment preferences. *Journal of Consulting Clinical Psychology, 69*(4), 717-721.

Resnick, B., & Jenkins, L. S. (2000). Testing the reliability and validity of the Self-Efficacy for Exercise scale. *Nursing Research, 49*(3), 154-159.

Richelsen, B., Tonstad, S., Rossner, S., Toubro, S., Niskanen, L., Madsbad, S., et al. (2007). Effect of orlistat on weight regain and cardiovascular risk factors following a very-low-energy diet in abdominally obese patients: A 3-year randomized, placebo-controlled study. *Diabetes Care, 30*(1), 27-32.

Richman, R. M., Loughnan, G. T., Droulers, A. M., Steinbeck, K. S., & Caterson, I. D. (2001). Self-efficacy in relation to eating behaviour among obese and non-obese women. *International Journal of Obesity, 25*(6), 907-913.

Rickel, K. A., Gibbons, L. M., Milsom, V. A., DeBraganza, N., Murawski, M. E., Nackers, L. M., et al. (2007). Racial/ethnic differences in the effectiveness of extended care following lifestyle intervention for obesity. *Annals of Behavioral Medicine, 33*, (Suppl.), S083.

Riebe, D., Blissmer, B., Greene, G., Caldwell, M., Ruggiero, L., Stillwell, K. M., et al. (2005). Long-term maintenance of exercise and healthy eating behaviors in overweight adults. *Preventive Medicine, 40*(6), 769-778.

Riksen, N. P., Zhou, Z., Oyen, W. J., Jaspers, R., Ramakers, B. P., Brouwer, R. M., et al. (2006). Caffeine prevents protection in two human models of ischemic preconditioning. *Journal of the American College of Cardiology, 48*(4), 700-707.

Rippe, J. M., Crossley, S., & Ringer, R. (1998). Obesity as a chronic disease: Modern medical and lifestyle management. *Journal of the American Dietetic Association, 98*(10 Suppl 2), S9-15.

Roach, J. B., Yadrick, M. K., Johnson, J. T., Boudreaux, L. J., Forsythe, W. A., & Billon, W. (2003). Using self-efficacy to predict weight loss among young adults. *Journal of the American Dietetic Association, 103*(10), 1357-1359.

Rosenthal, R. (1984). *Meta-analytic procedures for social research* (revised ed. Vol. 6). Newbury Park, CA: Sage Publications.

Roth, J., Qiang, X., Marban, S. L., Redelt, H., & Lowell, B. C. (2004). The obesity pandemic: Where have we been and where are we going? *Obesity Research, 12*(Suppl. 2), S88-S101.

Rothacker, D. Q. (2000). Five-year self-management of weight using meal replacements: Comparison with matched controls in rural Wisconsin. *Nutrition, 16*(5), 344-348.

Ryttig, K. R., Flaten, H., & Rossner, S. (1997). Long-term effects of a very low calorie diet (Nutrilett) in obesity treatment. A prospective, randomized, comparison between VLCD and a hypocaloric diet+behavior modification and their combination. *International Journal of Obesity, 21*(7), 574-579.

Sajatovic, M., Blow, F. C., Kales, H. C., Valenstein, M., Ganoczy, D., & Ignacio, R. V. (2007). Age comparison of treatment adherence with antipsychotic medications among individuals with bipolar disorder. *International Journal of Geriatric Psychiatry, 22*(10), 992-998.

Samaha, F. F., Iqbal, N., Seshadri, P., Chicano, K. L., Daily, D. A., McGrory, J., et al. (2003). A low-carbohydrate as compared with a low-fat diet in severe obesity. *New England Journal of Medicine, 348*(21), 2074-2081.

Saris, W. H. (2001). Very-low-calorie diets and sustained weight loss. *Obesity Research, 9*(Suppl. 4), 295S-301S.

Sarlio-Lahteenkorva, S., Rissanen, A., & Kaprio, J. (2000). A descriptive study of weight loss maintenance: 6 and 15 year follow of initially overweight adults. *International Journal of Obesity, 24*, 116-125.

Satia, J. A., Galanko, J. A., & Neuhouser, M. L. (2005). Food nutrition label use is associated with demographic, behavioral, and psychosocial factors and dietary intake among African Americans in North Carolina. *Journal of the American Dietetic Association, 105*(3), 392-402.

Satia-Abouta, J., Galanko, J. A., Potter, J. D., Ammerman, A., Martin, C. F., & Sandler, R. S. (2003). Associations of total energy and macronutrients with colon cancer risk in African Americans and Whites: Results from the North Carolina colon cancer study. *American Journal of Epidemiology, 158*(10), 951-962.

Schoeller, D. A., Shay, K., & Kushner, R. F. (1997). How much physical activity is needed to minimize weight gain in previously obese women? *American Journal of Clinical Nutrition, 66*, 551-556.

Schoeller, D. A., & van Santen, E. (1982). Measurement of energy expenditure in man by the doubly labeled water method. *Journal of Applied Physiology, 53*, 95-99.

Schoeller, D. A., & Webb, P. (1984). Five-day comparison of the doubly labeled water method with respiratory gas exchange. *American Journal of Clinical Nutrition, 40*, 153-158.

Schwarzer, R., & Renner, B. (2000). Social-cognitive predictors of health behavior: Action self-efficacy and coping self-efficacy. *Health Psychology, 19*(5), 487-495.

Sheehan, T. J., DuBrava, S., DeChello, L. M., & Fang, Z. (2003). Rates of weight change for black and white Americans over a twenty year period. *International Journal of Obesity, 27*(4), 498-504.

Shick, S. M., Wing, R. R., Klem, M. L., McGuire, M. T., Hill, J. O., & Seagle, H. (1998). Persons successful at long-term weight loss and maintenance continue to consume a low-energy, low-fat diet. *Journal of the American Dietetic Association, 98*(4), 408-413.

Sjöström, L., Rissanen, A., Andersen, T., Boldrin, M., Golay, A., Koppeschaar, H. P., et al. (1998). Randomised placebo-controlled trial of orlistat for weight loss and prevention of weight regain in obese patients. *Lancet, 352*(9123), 167-172.

Smith, C. F., Burke, L. E., & Wing, R. R. (2000). Vegetarian and weight loss diets among young adults. *Obesity Research, 8*(2), 123-129.

Smith, S. C., Jr, Clark, L. T., Cooper, R. S., Daniels, S. R., Kumanyika, S. K., Ofili, E., et al. (2005). Discovering the full spectrum of cardiovascular disease: Minority Health Summit 2003. Report of the Obesity, Metabolic Syndrome, and Hypertension Writing Group. *Circulation, 111*(10), e134-e139.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhart (Ed.), *Sociological methodology* (pp. 290-312). San Francisco: Jossey-Bass.

Sorlie, P. D., Backlund, E. & Keller, J. B. (1995). US mortality by economic, demographic, and social characteristics: The National Longitudinal Mortality Study. *American Journal of Public Health, 85*(7), 949-956.

Speakman, J. (1997). *Doubly labelled water – Theory and practice*. London: Chapman and Hall.

Spencer, E. A., Appleby, P. N., Davey, G. K., & Key, T. J. (2002). Validity of self-reported height and weight in 4808 EPIC-Oxford participants. *Public Health Nutrition, 5*(4), 561-565.

St. Jeor, S. T. (2002). Measurement of food intake. In C. G. Fairburn & K. D. Brownell (Eds.), *Eating disorders and obesity* (pp. 126-130). New York: Guilford Press.

Stalonas, P. M., Perri, M. G., & Kerzner, A. B. (1984). Do behavioral treatments of obesity last? A five-year follow-up investigation. *Addictive Behaviors, 9*(2), 175-183.

Steptoe, A., Doherty, S., Kerry, S., Rink, E., & Hilton, S. (2000). Sociodemographic and psychological predictors of changes in dietary fat consumption in adults with high blood cholesterol following counseling in primary care. *Health Psychology, 19*(5), 411-419.

Steptoe, A., & Wardle, J. (2005). Cardiovascular stress responsivity, body mass and abdominal adiposity. *International Journal of Obesity, 29*(11), 1329-1337.

Steptoe, A., Wardle, J., Pollard, T. M., Canaan, L., & Davies, G. J. (1996). Stress, social support, and health-related behavior: A study of smoking, alcohol, consumption, and physical exercise. *Journal of Psychosomatic Research, 41*(2), 171-180.

Stetler, C. B., Brunell, M., Giuliano, K. K., Morse, D., Prince, L., & Newell-Stokes, V. (1998). Evidence-based practice and the role of nursing leadership. *Journal of Nursing Administration, 28*, 45-53.

Stevens, J., Truesdale, K. P., McClain, J. E., & Cai, J. (2006). The definition of weight maintenance. *International Journal of Obesity, 30*(3), 391-399.

Stevens, V. J., Obarzanek, E., Cook, N. R., Lee, I. M., Appel, L. J., Smith West, D., et al. (2001). Long-term weight loss and changes in blood pressure: Results of the Trials of Hypertension Prevention, phase II. *Annals of Internal Medicine, 134*(1), 1-11.

Stokes, M. E., Davis, S., & Koch, G. G. (2001). *Categorical data analysis using the SAS System* (2nd ed.). Gary, NC: SAS Publishing.

Stunkard, A. J., & Albaum, J. M. (1981). The accuracy of self-reported weights. *American Journal of Clinical Nutrition, 34*(8), 1593-1599.

Stunkard, A. J., & Berthold, H. C. (1985). What is behavioral therapy? A very short description of behavioral weight control. *American Journal Clinical Nutrition, 41*, 821-823.

Stunkard, A. J., & Penick, S. B. (1979). Behavior modification in the treatment of obesity. The problem of maintaining weight loss. *Archives of General Psychiatry, 36*(7), 801-806.

Sundquist, J., Winkleby, M. A., & Pudaric, S. (2001). Cardiovascular disease risk factors among older black, Mexican-American, and white women and men: An analysis of NHANES III, 1988-1994. Third National Health and Nutrition Examination Survey. *Journal of the American Geriatrics Society, 49*(2), 109-116.

Swinburn, B. A., Metcalf, P. A., & Ley, S. J. (2001). Long-term (5-year) effects of a reduced-fat diet intervention in individuals with glucose intolerance. *Diabetes Care, 24*(4), 619-624.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Boston: Allyn and Bacon.

Tataranni, P. A., Larson, D. E., Snitker, S., Young, J. B., Flatt, J. P., & Ravussin, E. (1996). Effects of glucocorticoids on energy metabolism and food intake in humans. *American Journal of Physiology, 271*, E317-325.

Tataranni, P. A., & Ravussin, E. (2002). Energy metabolism and obesity. In T. A. Wadden & A. J. Stunkard (Eds.), *Handbook of obesity treatment* (pp. 42-72). New York: Guilford press.

Tate, D. F., Jackvony, E. H., & Wing, R. R. (2003). Effects of Internet behavioral counseling on weight loss in adults at risk for type 2 diabetes: A randomized trial. *JAMA, 289*(14), 1833-1836.

Tate, D. F., Jeffery, R. W., Sherwood, N. E., & Wing, R. R. (2007). Long-term weight losses associated with prescription of higher physical activity goals. Are higher levels of physical activity protective against weight regain? *American Journal of Clinical Nutrition, 85*(4), 954-959.

Teixeira, P. J., Going, s. B., Houtkooper, L. B., Cussler, E. C., Metcalfe, L. L., Blew, R. M., et al. (2004). Pretreatment predictors of attrition and successful weight management in women. *International Journal of Obesity, 28*, 1124-1133.

The Look AHEAD Research Group. (2007). Reduction in weight and cardiovascular disease risk factors in individuals with type 2 diabetes: One-year results of the look AHEAD trial. *Diabetes Care, 30*(6), 1374-1383.

Timmerman, G. M., Reifsnider, E., & Allan, J. D. (2000). Weight management practices among primary care providers. *Journal of the American Academy of Nurse Practitioners, 12*(4), 113-116.

Toubro, S., & Astrup, A. (1997). Randomised comparison of diets for maintaining obese subjects' weight after major weight loss: Ad lib, low fat, high carbohydrate diet v fixed energy intake. *British Medical Journal, 314*(7073), 29-34.

Toobert, D. J., Strycker, L. A., Glasgow, R. E., Barrera Jr, M., & Angell, K. (2005). Effects of the mediterranean lifestyle program on multiple risk behaviors and psychosocial outcomes among women at risk for heart disease. *Annals of Behavioral Medicine, 29*(2), 128-137.

Troiano, R. P. (2005). A timely meeting: Objective measurement of physical activity. *Medicine & Science in Sports & Exercise, 37*(Suppl. 11), S487-489.

Tyler, D. O., Allan, J. D., & Alcozer, F. R. (1997). Weight loss methods used by African-American and Euro-American women. *Research in Nursing & Health, 20*(5), 413-423.

Unnebrink, K. & Windeler, J. (2001). Intention-to-treat: methods for dealing with missing values in clinical trials of progressively deteriorating diseases. *Statistics in Medicine, 20*(24), 3931-3946.

U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Center for Disease Control and Prevention, National Center for Chronic Disease Prevention and Promotion.

U.S. Department of Health and Human Services. (1997). Heart-healthy home cooking African American style. *NIH publication no. 97-3792*, Available at http://www.nhlbi.nih.gov/health/public/heart/other/chdblack/cooking.htm, accessed June 5, 2008.

U.S. Department of Health and Human Services. (2005). Dietary guidelines for Americans, 2005. Available at http://www.healthierus.gov/dietaryguidelines, accessed October 24, 2007.

U.S. Preventive Services Task Force. (2003). Screening and interventions to prevent obesity in adults. Available at http://www.ahrq.gov/clinic/uspstf/uspsobes.htm, accessed October 15, 2007.

Urban, N., White, E., Anderson, G. L., Curry, S., Kristal, A. R., Shattuck, A. L., et al. (1992). Correlates of maintenance of a low-fat diet among women in the Women's Health Trial. *Preventive Medicine, 21*, 279-291.

Van Duyn, M. A., Kristal, A. R., Dodd, K., Campbell, M. K., Subar, A. F., Stables, G., et al. (2001). Association of awareness, intrapersonal and interpersonal factors, and stage of dietary change with fruit and vegetable consumption: A national survey. *American Journal of Health Promotion, 16*(2), 69-78.

Verheijden, M. W., Bakx, J. C., van Weel, C., Koelen, M. A., & van Staveren, W. A. (2005). Role of social support in lifestyle-focused weight management interventions. *European Journal of Clinical Nutrition, 59*(Suppl. 1), S179-186.

Vgontzas, A. N., Lin, H. M., Papaliaga, M., Calhoun, S., Vela-Bueno, A., Chrousos, G. P., et al. (2008). Short sleep duration and obesity: The role of emotional stress and sleep disturbances. *Internation Journal of Obesity, 32*(5), 801-809.

Vijan, S., Stuart, N. S., Fitzgerald, J. T., Ronis, D. L., Hayward, R. A., Slater, S., et al. (2005). Barriers to following dietary recommendations in type 2 diabetes. *Diabetes Medicine, 22*(1), 32-38.

Villanova, N., Pasqui, F., Burzacchini, S., Forlani, G., Manini, R., Suppini, A., et al. (2006). A physical activity program to reinforce weight maintenance following a behavior program in overweight/obese subjects. *International Journal of Obesity, 30*(4), 697-703.

Vitaliano, P., Russo, J., Scanaln, J. M., & Greeno, C. G. (1996). Weight changes in caregivers of Alzheimer's care recipients: Psychobehavioral predictors. *Psychology & Aging, 11*(1), 155-163.

Vogels, N., & Westerterp-Plantenga, M. S. (2007). Successful long-term weight maintenance: A 2-year follow-up. *Obesity, 15*(5), 1258-1266.

Vogels, N. & Westerterp-Plantenga, M. S. (2005). Categorical strategies based on subject characteristics of dietary restraint and physical activity, for weight maintenance. *International Journal of Obesity, 29*, 849-857.

Votruba, S. B., Horvitz, M. A., & Schoeller, D. A. (2000). The role of exercise in the treatment of obesity. *Nutrition, 16*, 179-188.

Wadden, T. A., Anderson, D. A., & Foster, G. D. (1999). Two-year changes in lipids and lipoproteins associated with the maintenance of a 5% to 10% reduction in initial weight: Some findings and some questions. *Obesity Research, 7*(2), 170-178.

Wadden, T. A., Anderson, D. A., Foster, G. D., Bennett, A., Steinberg, C., & Sarwer, D. B. (2000). Obese women's perceptions of their physicians' weight management attitudes and practices. *Archives of Family Medicine, 9*(9), 854-860.

Wadden, T. A., Bartlett, S. J., Foster, G. D., Greenstein, R. A., Wingate, B. J., Stunkard, A. J., et al. (1995). Sertraline and relapse prevention training following treatment by very-low-calorie diet: A controlled clinical trial. *Obesity Research, 3*(6), 549-557.

Wadden, T. A., Berkowitz, R. I., Womble, L. G., Sarwer, D. B., Phelan, S., Cato, R. K., et al. (2005). Randomized trial of lifestyle modification and pharmacotherapy for obesity. *New England Journal of Medicine, 353*(20), 2111-2120.

Wadden, T. A., Brownell, K. D., & Foster, G. D. (2002). Obesity: Responding to the global epidemic. *Journal of Consulting and Clinical Psychology, 70*(3), 510-525.

Wadden, T. A., & Butryn, M. L. (2003). Behavioral treatment of obesity. *Endocrinology & Metabolism Clinics of North America, 32*(4), 981-1003.

Wadden, T. A., Butryn, M. L., & Byrne, K. J. (2004). Efficacy of lifestyle modification for long-term weight control. *Obesity Research,* (Suppl. 12), S151-162.

Wadden, T. A., Foster, G. D., & Letizia, K. A. (1994). One-year behavioral treatment of obesity: Comparison of moderate and severe caloric restriction and the effects of weight maintenance therapy. *Journal of Consulting & Clinical Psychology, 62*(1), 165-171.

Wadden, T. A., & Osei, S. (2002). The treatment of obesity: An overview. In T. A. Wadden & A. J. Stunkard (Eds.), *Handbook of obesity treatment*. New York: Guilford Press.

Wadden, T. A., & Phelan, S. (2002). Behavioral assessment of the obese patient. In: Wadden, T. A. & Stunkard, A. J. (Eds.), *Handbook of obesity treatment* (pp. 186-226). New York: Guilford Press.

Wadden, T. A., Vogt, R. A., Foster, G. D., & Anderson, D. A. (1998). Exercise and the maintenance of weight loss: 1-year follow-up of a controlled clinical trial. *Journal of Consulting & Clinical Psychology, 66*(2), 429-433.

Walcott-McQuigg, J. A. (1995). The relationship between stress and weight-control behaviors in African American women. *Journal of the National Medical Association, 87*(6), 427-432.

Walcott-McQuigg, J. A., Chen, S. P., Davis, K., Stevenson, E., Choi, A., & Wangsrikhun, S. (2002). Weight loss and weight loss maintenance in African-American women. *Journal of the National Medical Association, 94*(8), 686-694.

Waldstein, S. R., Burns, H. O., Toth, M. J., & Poehlman, E. T. (1999). Cardiovascular reactivity and central adiposity in older African Americans. *Health Psychology, 18*(3), 221-228.

Walsh, M. C., Hunter, G. R., Sirikul, B., & Gower, B. A. (2004). Comparison of self-reported with objectively assessed energy expenditure in black and white women before and after weight loss. *American Journal of Clinical Nutrition, 79*(6), 1013-1019.

Wardle, J., & Gibson, E. L. (2002). Impact of stress on diet: Processes and implications. In S. A. Stansfeld & M. G. Marmot (Eds.), *Stress and the heart: Psychosocial pathways to coronary heart disease* (pp. 124-149). London: BMJ Books.

Ware, J. H. (2003). Interpreting incomplete data in studies of diet and weight loss. *New England Journal of Medicine, 348*(21), 2136-2137.

Warziski, M. T., Sereika, S. M., Styn, M. A., Music, E., & Burke, L. E. (2008). Changes in self-efficacy and dietary adherence: The impact on weight loss in the PREFER study. *Journal of Behavioral Medicine, 31*, 81-92.

Washburn, R. A., Jacobsen, D. J., Sonko, B. J., Hill, J. O., & Donnelly, J. E. (2003). The validity of the Stanford Seven-Day Physical Activity Recall in young adults. *Medicine & Science in Sports & Exercise, 35*(8), 1374-1380.

Weinsier, R. L., Hunter, G. R., Schutz, Y., Zuckerman, P. A., & Darnell, B. E. (2002). Physical activity in free-living, overweight white and black women: Divergent responses by race to diet-induced weight loss. *American Journal of Clinical Nutrition, 76*, 736-742.

Westerterp-Plantenga, M. S., Lejeune, M. P., & Kovacs, E. M. (2005). Body weight loss and weight maintenance in relation to habitual caffeine intake and green tea supplementation. *Obesity Research, 13*(7), 1195-1204.

Westerterp-Plantenga, M. S., Lejeune, M. P., Nijs, I., van Ooijen, M., & Kovacs, E. M. (2004). High protein intake sustains weight maintenance after body weight loss in humans. *International Journal of Obesity, 28*(1), 57-64.

White, M. A., Martin, P. D., Newton, R. L., Walden, H. M., York-Crowe, E. E., Gordon, S. T., et al. (2004). Mediators of weight loss in a family-based intervention presented over the internet. *Obesity Research, 12*(7), 1050-1059.

Wier, L. T., Ayers, G. W., Jackson, A. S., Rossum, A. C., Poston, W. S., & Foreyt, J. P. (2001). Determining the amount of physical exercise needed for long-term weight control. *International Journal of Obesity, 25*, 613-621.

Williamson, D. F. (1993). Descriptive epidemiology of body weight and weight change in U.S. adults. *Annals of Internal Medicine, 119*, 646-649.

Wing, R. R. (1998). Behavioral approaches to the treatment of obesity. In G. A. Bray, C. Bourchard & W. P. T. James (Eds.), *Handbook of obesity* (pp. 855-877). New York: Marcel Dekker.

Wing, R. R. (1999). Physical activity in the treatment of adulthood overweight and obesity: Current evidence and research issues. *Medicine & Science in Sports & Exercise, 31*, S547-552.

Wing, R. R. (2004). Behavioral approaches to the treatment of obesity. In G. A. Bray, C. Bourchard & W. P. T. James (Eds.), *Handbook of obesity: Clinical applications* (2nd ed., pp. 147-167). New York: Marcel Dekker.

Wing, R. R., & Anglin, K. (1996). Effectiveness of a behavioral weight control program for Blacks and Whites with NIDDM. *Diabetes Care, 19*(5), 409-413.

Wing, R. R., & Hill, J. O. (2001). Successful weight loss maintenance. *Annual Review of Nutrition, 21*, 323-341.

Wing, R. R., & Jeffery, R. W. (1999). Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. *Journal of Consulting and Clinical Psychology, 67*(1), 132-138.

Wing, R. R., & Jeffery, R. W. (2003). Prescribed "breaks" as a means to disrupt weight control efforts. *Obesity Research, 11*(2), 287-291.

Wing, R. R., Jeffery, R. W., Hellerstedt, W. L., & Burton, L. R. (1996). Effect of frequent phone contacts and optional food provision on maintenance of weight loss. *Annals of Behavioral Medicine, 18*(3), 172-176.

Wing, R. R., & Phelan, S. (2005). Long-term weight loss maintenance. *American Journal Clinical Nutrition, 82*(Suppl. 1), S222-225.

Wing, R. R., Tate, D. F., Gorin, A. A., Raynor, H. A., & Fava, J. L. (2006). A self-regulation program for maintenance of weight loss. *New England Journal of Medicine, 355*(15), 1563-1571.

Wirth, A., & Krause, J. (2001). Long-term weight loss with sibutramine: A randomized controlled trial. *JAMA, 286*(11), 1331-1339.

Wolfe, W. A. (2000). Obesity and the African-American woman: A cultural tolerance of fatness or other neglected factors. *Ethnicity & Disease, 10*(3), 446-453.

Wolfe, W. A. (2004). A review: maximizing social support- A neglected strategy for improving weight management with African-American women. *Ethnicity & Disease, 14*(2), 212-218.

World Health Organization. (1997). *Preventing and managing the global epidemic of obesity: Report of the World Health Organization consultation on obesity*. Geneva: WHO.

Wyatt, H. R., Grunwald, G. K., Mosca, C. L., Klem, M. L., Wing, R. R., & Hill, J. O. (2002). Long-term weight loss and breakfast in subjects in the National Weight Control Registry. *Obesity Research, 10*(2), 78-82.

Yeh, M. C., Rodriguez, E., Nawaz, H., Gonzalez, M., Nakamoto, D., & Katz, D. L. (2003). Technical skills for weight loss: 2-y follow-up results of a randomized trial. *International Journal of Obesity, 27*(12), 1500-1506.

Young, D. R., Gittelsohn, J., Charleston, J. B., Felix-Aaron, & Appel, L. J. (2001). Motivations for exercise and weight loss among African-American women: Focus group results and their contribution towards program development. *Ethnicity & Health, 6*, 227-245.

Zenk, S. N., Schulz, A. J., Hollis-Neely, T., Campbell, R. T., Holmes, N., Watkins, G., et al. (2005). Fruit and vegetable intake in African Americans: Income and store characteristics. *American Journal of Preventive Medicine, 29*(1), 1-9.

Zhao, L. P., & Kolonel, L. N. (1992). Efficiency loss from categorizing quantitative exposures into qualitative exposures in case-control studies. *American Journal of Epidemiology, 136*(4), 464-474.